Arkansas Math and Science Partnership Project Evaluation for 2012-2013

Project Conducted by the Arkansas Department of Education

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Table of Contents

Executive Summary…… 4

- Characteristics of MSP Projects and Participants…… 4
- Teacher Content Knowledge Gains…… 5
- Professional Development Content and Models…….. 5
- Project Evaluation Design…… 5
- Conclusions…….. 6

Section 1: Introduction…… 7

- Overview of the Mathematics and Science Partnership Program…… 7
- Professional Development…… 8
- MSP Project Logic Model…… 10
- Overview of the MSP Evaluation…… 12
- Purpose of This Report…… 13
- Organization of This Report…… 13

Section 2: Characteristics of MSP Projects and Participants……14

- Program Description…… 14
- Amount of Funding…… 15
- Organization and Partnerships…… 16
- Attrition…….. 22
- Administrators Involvement……... 22

Section 3: Teacher Content Knowledge Gains…… 23

- Increasing Teacher Content Knowledge…… 23
- Results…… 23
- Pedagogical Practice…… 27
  - Getting to the Core…….. 28
  - UA Engineering and Math Partnership…… 29
  - The South Arkansas Mathematics Standards Partnership…….. 29
  - Math Core Team…….. 30
  - 6ht – 8th Grade Algebra…… 30
  - 6th – 8th Grade Geometry…… 31
  - Common Core Boot Camp…….. 32
  - Thinking Mathematically…… 33
- Changes in Instructional Practices…… 34

Section 4: Student Outcomes…… 37

- Measuring Student Achievement…… 37

Mathematics Core Team…… 39
South Arkansas Mathematics Standards Partnership…… 39
UA Engineering and Mathematics Partnership……... 39
Thinking Mathematically…… 40
6^{th} – 8^{th} Grade Algebra……. 40
6^{th} – 8^{th} Grade Geometry…….. 41
Getting to the Core…… 42
Common Core Boot Camp…… 42

Section 5: Professional Development Content and Models……. 45

Methods of Professional Development…… 45
Content of MSP Projects…….. 46
Professional Development Models…….. 48
Modeling Strategies Connecting Subject Matter to the Classroom…….. 49

Section 6: Project Evaluation Design…… 51

Evaluators and Evaluation Designs…….. 51
Overview of Data Collection…… 52
Approaches and Strategies for Data Collection…… 52
Data Analysis and Reporting. …….. 53
Data and Assessment…… 53
Pedagogical Knowledge…… 54
Attitudes and Perceptions…….. 54
Impact of MSP……. 55

Section 7: Conclusions and Recommendations…… 56

Conclusions…….. 56
Recommendations…… 58
Next Steps…… 61

References…… 62

Appendix: Project Summaries……. 64

Tables

Table 2.1: MSP Project Titles and Key Identifiers…… 16

Table 2.2: MSP Project Lead Organization Type and Mean Faculty Participants…… 18

Table 2.3: IHE Faculty Participants by Department…… 18

Table 2.4: Number of Participating Partners and Districts…… 19

Table 2.5: Number of Participants and Expenditure per Participants…….. 20

Table 2.6: Participants by School Level……... 20

Table 2.7 Targeted Population and Number of Students Served…… 21

Table 3.1: Meta-Analysis of Cohort 6……....24

Table 3.2: Percent of Teachers with gains in Content Knowledge……... 26

Table 3.3: RTOP Data 2012-2013…… 28

Table 4.1: Student Benchmark Results…… 38

Table 5.1: Professional development in Mathematical Processes Provided By School Level…… 47

Table 5.2: Methods of Professional Development and Contact Hours …… 49

Table 6.1: Content Knowledge Instruments Utilized by MSP Projects…… 54

Figures

Figure 1.1: MSP Program Funding, Fiscal Years 2004-2012…….. 8

Figure 3.1: Meta-Analysis…… 25

Figure 3.2: Percent of Teachers with Significant Gains…… 27

Executive Summary

Our nation's students are underachieving in mathematics and science compared to students in other industrialized nations. Research suggests that increased teacher content knowledge and teaching skills lead to improved student achievement (Hill, Rowan & Ball, 2005; Goe, 2007; Krauss, Baumert, & Blum, 2008). The purpose of the Arkansas Mathematics and Science Partnership (MSP) program is to improve student learning in mathematics and science through intensive, high-quality professional development activities that focus on enhancing teachers' content and pedagogical knowledge.

The MSP program is a formula grant program to the states, with the size of individual state awards based on counts of students living in poverty. With these funds, each state administers a grant competition, in which awards are made to partnerships to improve teacher knowledge and skills in mathematics and science.

Since 2004, the USDE Math and Science Partnership (MSP) program has awarded Arkansas over $18,300,000 to fund 47 partnerships. The partnerships between institutions of higher education, high need school systems, and other qualifying partners design, deliver, and evaluate professional activities intended to increase teacher content skills.

USDE awarded Arkansas over $1,600,000 during the 2012-2013 funding period to fund eight partnerships in Cohort 6 for their second year of a three year project. Year 2 is the focus of this evaluation.

Characteristics of MSP Projects and Participants

Thirty-eight faculty members from institutions of higher education including 29 from STEM areas were involved with the MSP projects in Performance Period (PP) 2013, with an average of 4.75 IHE faculty members per project. MSP projects reporting in 2013 had an average of 16 partner organizations and eight school districts. The number of partners ranged from four to 27. The number of school districts ranged from one to 21.

The number of participants involved in MSP professional development across all projects in 2012-2013 was 313. This number is down from 336 last year. The number of each project's participants ranged from 21 to 81. Expenditures per participant ranged from $3,231 to $7,502 with the average expenditure being $4,708.

The target population for Cohort 6 MSP professional development is classroom teachers in grades 3-8. MSP participants are distributed across school levels as follows: 43 percent at the elementary level, 56 percent at the middle school level, and one percent at the high school level. Across all projects, 23,440 students benefited from the MSP.

Teacher Content Knowledge Gains

Increasing teacher content knowledge is important to achieving changes in teacher practices. Six of the eight funded projects in Cohort 6 reported significant gains in teacher content knowledge. The percent of teachers with significant gains ranged from 0 to 95 percent. For 2012-2013 a meta-analysis is also provided. The individual effect sizes (Fisher z-transformation) ranges from -0.102 to .82 with an overall score of 0.18—consider a small change. In education, if it could be shown that making a small change would raise academic achievement by an effect size of even as little as 0.1, then this could be a very significant improvement, particularly if the effect were cumulative over time (Coe, 2002).

Professional Development Content and Models

In recent decades, school reform efforts have recognized teacher professional development as a key component of change and as an important link between the standards movement and student achievement. Many research studies have identified components of in-service teacher professional development programs that have an effect on practice and student learning. The first component is the substantial time that needs to be invested in the professional development experience for it to have an effect on teacher practices and ultimately student learning.

The professional development activities offered by MSP projects focus on increasing teachers' content knowledge in mathematics and enhancing their pedagogical skills. All projects offered summer institutes with school-year follow-up activities. Projects reported offering from 98 to 112 hours of professional development with the average being 102 hours. An equal number of projects reported delivering professional development on-site and off-site. All projects used Reformed Teaching Observation Protocol (RTOP) to assess classroom practice.

Most MSP projects addressed multiple content areas and topics. Across schools, algebra was the most frequently addressed content area with six (75%) projects offering professional development in this area. Five projects (63%) offered professional development in mathematical practice, number and operations, and problem solving. Probability and statistics was the least frequently addressed content area with only one project concentrating on this area.

Respondents were generally positive about their perceptions of local MSP progress toward objectives. Projects noted changes in teacher knowledge and instructional practices.

Project Evaluation Design

The Math and Science Partnership program represents a significant investment by the US Department of Education (USDE). Accordingly, project-level evaluations are critical to helping the USDE understand and assess the value of its investment. MSP projects reported the primary designs they used to assess program outcomes. All projects reported using a quasi-experimental

design with 25 percent using a matched comparison group design and 75 percent using a non-matched comparison group. All projects reported using a pre-test and post-test to assess the content knowledge gains of the teachers severed by MSP.

The most frequently reported assessments of teacher content knowledge in mathematics were national normed/standardized tests (7 or 88 percent of projects.) The project that did not use nationally normed or standardized content assessments developed their own assessments.

All projects shared common goals: improving teacher content knowledge and teaching methods. And for all eight projects the primary target was individual teachers as opposed to whole school reform.

Conclusions

The first year of the project was focused on establishing infrastructure, which required rather rigid adherence to MSP policies. The second year the projects spent more time on applying lessons to the Common Core. Teachers participating in the MSP professional development received intensive and sustained content-rich professional development form college and university faculty partners. Participants reported becoming more comfortable in changing their mathematical practices and enjoyed developing lessons that can be used in teaching the Common Core. Participants increased awareness of research-based instructional practices and materials and enjoyed collaborating with different partners and building relationships with IHE faculty.

Section 1: Introduction

Our nation's students are underachieving in mathematics and science compared to students in other industrialized nations. On international tests of science and mathematics such as Trends in International Mathematics and Science Study (TIMSS) and Program for International Student Assessment (PISA) American students ranked 23rd in math and 31st in science when compared with 65 other top industrial countries. Only 26 percent of our nation's high school seniors perform at proficient levels or above in mathematics and only 21 percent of our nation's high school seniors perform at proficient levels or above in science (Provasnik, 2012).

The Science and Engineering Readiness Index (SERI) measures how high school students are performing in physics and calculus--based on publicly available data. The SERI score given to each state is based on a scale from 1 to 5 and reflects how well states perform. Arkansas was one of 21 states to earn a ranking of "below average" or "far below average" with a score of 2.14 (41st out of 50). The national average is 2.82. State scores range from 1.11 to 4.82 (Blue, 2011). Clearly there is much room for improvement in science and mathematics education in Arkansas.

Research suggests that increased teacher content knowledge and teaching skills lead to improved student achievement (Hill, Rowan & Ball, 2005; Goe, 2007; Krauss, Baumert, & Blum, 2008). Therefore, education improvement efforts increasingly focus on the teachers as the most powerful approach to increase student learning.

Overview of the Mathematics and Science Partnership Program

In January 2002, the No Child Left Behind Act of 2001 (NCLB) became law (Public Law 107-110). Title II, Part B of this legislation authorized the MSP competitive grant program. The MSP is intended to increase the academic achievement of students in mathematics and science by enhancing the subject matter knowledge and teaching skills of classroom teachers. Partnerships between high-need school districts and the science, technology, engineering, and mathematics (STEM) faculty in institutions of higher education (IHE) are at the core of these improvements efforts. STEM faculty's substantial intellectual engagement in these projects is one of the attributes that distinguishes the MSP program from other programs seeking to improve K-12 student outcomes in mathematics and science.

The MSP program is a formula grant program to the states, with the size of individual state awards based on counts of students living in poverty. With these funds, each state administers a grant competition, in which awards are made to partnerships to improve teacher knowledge and skills in mathematics and science.

Figure1 shows how federal support for the MSP program in Arkansas increased substantially from the program's inception in FY 2004 ($1,025,320). Funding has remained above $1,600,000 since FY 2005 reaching a high in FY 2010 of $2,137,830. Funding for the 2012-2013 year was $1,611,191.

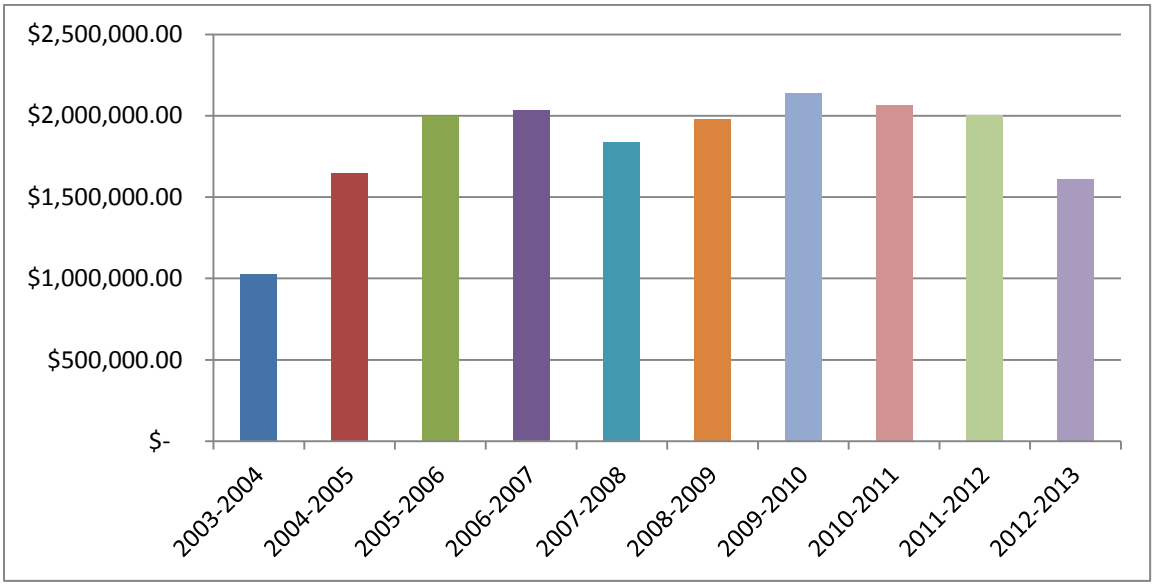


Figure 1: MSP Program Funding, Fiscal Years 2004-2013

The Arkansas Department of Education (ADE) is responsible for the administration of this program. Funds available for the MSP program were awarded by the ADE to support successful proposals submitted by Arkansas institutions of higher education (IHEs), school districts, or nonprofit organizations (NPOs) that have formed partnerships focused on the improvement of mathematics and/or science instruction in grades K-12. Each partnership formed was based on its own regional needs and history of partnering; therefore partnerships varied in terms of number of districts and IHEs included. Partnerships included, at a minimum, a high-need district and a department of mathematics, science, or engineering in an IHE. For the purposes of the Arkansas MSP program, ADE defines a high-need district as one that has 25 percent or more of the students on free or reduced lunch *and* has one or more schools designated as a school in improvement. In the state of Arkansas, there are eight funded projects in Cohort 6. The number of school districts included in the partnerships ranges from one to 21.

The MSP professional development model recognizes that curricular and pedagogical reform is at the heart of sustainable change in mathematics and science education. Arkansas' MSP programs are designed to provide a challenging curriculum for every student by providing rigorous professional development opportunities to teachers that focus on continuously upgrading teachers' knowledge and skills. The MSP conceptual logic model on the following

page illustrates the interrelationships among the MSP program's goals, activities, and structure. Logic models are commonly used in evaluation, and offer visual representations of a program's path to achieving intended outcomes (Kellogg Foundation, 2006).

MSP Project Logic Model					
INPUTS	**ACTIVITIES**		**OUTCOMES**		
Resources	**Professional Development**	**Output**	**Short Term Outcomes (Increases in knowledge, skills, and awareness)**	**Mid-Term Outcomes (changes in behavior, policy or implementation of practice)**	**Long-Term Outcomes (project goals)**
USDE funding MSP staff and coordinators Partnerships	Workshops and Seminars Develop products, facilitate access to information Network connections Math curriculum frameworks	Individual's exposure to skills and knowledge-enriching activities Common Core Curriculum planning materials Refined math curriculum framework; science curriculum framework Access to inquiry-based instructional materials Opportunities for networking	Increased awareness and knowledge of research-based instructional practices & materials Increase in teacher content knowledge Increased leadership skills Increased awareness of the importance of using the math and science curriculum frameworks Increased collaborations among partners Increased awareness of cultural differences	Changes in classroom instructional practices at both IHE and K-12 levels Adoption of inquiry based instructional materials Alignment of curriculum with PD and State Common Core standards Implementation of onsite PD led by teacher leaders Creation of professional learning communities	Increased K-12 students' knowledge of mathematics and science Increased quality and quantity of the K-16 educator workforce Sustained partnerships with IHEs Improved math and science learning experiences for all K-16.

Inputs: Inputs are the resources that support or guide the MSP activities. The USDE provides the funding to support the MSP activities. MSP staff including the MSP director and project coordinators facilitates many activities through coordinating and maintaining contact with the different partners. Partnerships are the core of the program.

Activities: The inputs support the activities necessary to bring about outputs. Professional development is the major impetus for bringing about change. Continuous, long term professional development that includes content and pedagogical knowledge workshops is the primary avenue that may lead to student achievement.

Outputs: Outputs are the direct and tangible products of the MSP activities. There are five major outputs from the MSP activities: 1) individuals' exposure to skills and knowledge-enriching activities; 2) Common Core Curriculum and planning materials; 3) refined math curriculum frameworks; 4) materials/tools that can be accessed and utilized for courses, curriculum and district planning; and 5) opportunities for interactions and networking.

Outcomes: The next three columns list the expected outcomes that develop from these outputs. Short term outcomes are defined as increase in knowledge, skills, and awareness. Many short term outcomes describe the kinds of increases in knowledge, skills, and awareness that are expected for the instructional leaders. For example, we expect to see evidence of increases in awareness and knowledge of research-based practices and materials, teacher content knowledge, and leadership skills, and an increase in STEM faculty involvement. Mid-term outcomes are the changes in behavior or practice that occur presumably as a result of the increases in knowledge, skills, and awareness. Together, the changes outlined in the mid-term outcomes should lead to achievement of the project goals which are defined as the long-term outcomes.

Theory of Action: The theory of action that undergirds the MSP logic model is based on the view that student achievement in mathematics and science can be improved by classroom teachers who are willing to become learners and deepen their own conceptual understanding of mathematics and science. This theory of action argues that providing teachers with opportunities to deepen their content and pedagogical knowledge in the context of high-quality instructional materials will result in better prepared teachers. Improved instruction will, in turn, lead to higher student achievement.

Both the MSP logic model and research evaluation questions provide a framework to guide the evaluation.

Overview of the MSP Evaluation

Every MSP project is required to design and implement an evaluation and accountability plan locally that allows for an assessment of its effectiveness. Projects are required to report annually on two aspects of their evaluation findings: 1) gains in teacher content knowledge based on pre- and post-testing; and 2) proficiency levels on state-level assessments of students of teachers who received professional development. In addition to each partnership's own local evaluation, the National Office of Measurement and Evaluation Systems (NORMES) at the University of Arkansas have contracted with the Arkansas Department of Education since 2006 to assist with yearly statewide evaluations of the MSP projects.

Based on the goals of the MSP program, the questions guiding these evaluations include the following:

1. Did Arkansas' MSP projects provide professional development with significant and meaningful content that models the instructional strategies that will enable teachers to teach in a manner that will improve student achievement in mathematics and/or science?

2. Did Arkansas' MSP projects improve and upgrade the status and stature of mathematics and/or science teaching by encouraging IHEs to assume greater responsibility for improving mathematics and/or science teacher education through the establishment of a comprehensive, integrated system of professional development that continuously stimulates teachers' intellectual growth and upgrades teachers' knowledge and skills?

3. Did Arkansas' MSP projects provide opportunities to focus on ways to deepen teachers' subject matter knowledge, increase teachers' knowledge of how students learn particular subject matter, provide opportunities for engaging learning, and establish coherence in teachers' professional development experiences?

4. Did Arkansas' MSP projects bring mathematics and/or science teachers in elementary schools and secondary schools together with scientists, mathematicians, and engineers to increase the subject matter knowledge of mathematics and/or science teachers and improve such teachers' teaching skills?

5. Did Arkansas' MSP projects develop more concise and rigorous instructional resources that are precisely aligned to state and local academic content standards and with the standards expected for preparation of students for postsecondary study in engineering, mathematics, and science?

6. Did Arkansas' MSP projects provide opportunities to improve and expand training of mathematics and/or science teachers, including training such teachers in the effective integration of technology into curricula and instruction?

Purpose of this Report

This report is the second in a series of three annual evaluation reports that details the evolution of the MSP Cohort 6. The primary purpose of this report is to provide formative assessment of activities to date. This report presents a summary of the data for projects in their second year of funding for Performance Period 2013. The findings presented in this report are primarily based on annual performance report (APR) data submitted by all MSP projects by September 30, 2013.

Organization of this Report

The remainder of this report is organized into seven sections and the appendix, as follows:

Section 2: Characteristics of MSP Projects and Participants

Section 3: Teacher Content Knowledge Gains

Section 4: Student Achievement

Section 5: Professional Development Content, Models, and Activities

Section 6: Project Evaluation Designs

Section 7: Conclusions and Recommendations

References

Appendix: Project Summaries

Section 2:
Characteristics of MSP Projects and Participants

This section describes the MSP program and the general characteristics of the MSP projects. It provides information on the amounts of funding awarded to MSP projects, the types and number of partners involved in MSP projects, and the number of teachers and students served by MSP projects.

Program Description

The MSP program is a major research and development effort that supports innovative partnerships to improve K-12 student achievement in mathematics and science. MSP projects are expected to both raise the achievement levels of all students and significantly reduce achievement gaps in the mathematics and science performance of diverse student populations by enhancing the content knowledge and teaching skills of classroom teachers. Successful projects serve as models that can be widely replicated in educational practice to improve the mathematics and science achievement of all the nation's students (NSF, 2003).

Partnerships between high-need school districts and the science, technology, engineering, and mathematics (STEM) faculty in institutions of higher education are at the core of these improvement efforts. Other partners may include state education agencies, public charter schools or other public schools, businesses, and nonprofit or for-profit organizations concerned with mathematics and science education.

Consistent with the objectives of the overall MSP program, the primary goals of this partnership are to increase K-12 students' knowledge of mathematics and science thereby preparing them to be successful in advanced math and science courses; enhance the quality, quantity and diversity of the K-12 mathematics and science teacher workforce; create sustainable partnerships with IHEs; and improve the mathematics and science learning experiences for all undergraduates.

These goals will be accomplished through three intervention strategies:

- Professional development for content and pedagogy is accomplished through workshops and seminars for K-12 educators led by university faculty and experts in the field.

- Curriculum alignment and pedagogical and course enhancement is accomplished at the K-12 level through the use of curriculum frameworks.

- Support for and dissemination of research based resources and tools is primarily accomplished through the state MSP office and networks of educators using research-based curricula.

The first strategy is designed to create teachers who are knowledgeable and confident in using research-based teaching strategies in teaching mathematics with the end result being improved student performance in mathematics. The second strategy of curriculum alignment and pedagogical and course refinement is accomplished through the use of math and science curriculum frameworks for the State Common Core Standards at the K-12 level. Finally, the third strategy of disseminating and supporting the use of research-based resources and tools is achieved in part through network connections, individual MSP partnership websites, and the state MSP office.

Amount of Funding

The MSP program is a formula grant program to the states, with the size of individual state awards based on student population and poverty rates. With these funds, each state is responsible for administering a grant competition, in which grants are made to partnerships to improve teacher knowledge in mathematics and science. All projects in Cohort 6 received their initial award on August 5, 2011 and their renewal award on August 5, 2012. The amount of funding for individual projects ranged from $129,229 to the $350,454 with an average funding level of $175,172. All projects in Cohort 6 completed their second year of implementation. Table 2.1 lists award amounts for each project.

Table 2.1

MSP Project Titles and Key Identifiers

MSP Project Title	Project Director	Lead Organization	Award Amount
Common Core Boot Camp	Julie Grady	Arkansas State University	$157,547
Thinking Mathematically for Common Core State Standards in Grades 3-5	Beth Neel	Dawson ESC	$139,622
6th-8th grade Algebra Common Core Initiative	Angelia Carlton	Northeast ESC	$162,353
The South Arkansas Mathematics Standards Project	Roger Guevara	South Central ESC	$167,807
University of Arkansas Engineering and Mathematics Partnership	Bryan Hill	University of Arkansas	$350,454
Getting to the Core: Grades 3-5 Mathematics Partnership	Shannon Dingman	University of Arkansas	$129,229
Math Core Team	Uma Garimella	University of Central Arkansas	$131,041
6th-8th Grade Common Core Geometry Project	Tony Finley	Wilbur D. Mills ESC	$163,323

Organization and Partnerships

The MSP program requires partnerships to include institutions of higher education (IHE) or eligible nonprofit organization (or consortium of such institutions or organizations) and one or more local education agencies (LEAs) that may also include a state educational agency or one or more businesses. Successful partnership building requires a significant amount of time, money, and effort—all of which may be considered valuable resources.

Partnerships between IHEs and school districts offer mutual benefits of respect and professionalism. Sustainability of the partnerships depends, in large part, on the IHEs recognizing the benefits of participating in the MSP. Most STEM faculty members do not receive any formal training in teaching. Consequently they tend to teach the way they have been taught, which is typically using a lecture-based format. As a result of MSP participation, faculty members have been exposed to different teaching strategies. Through participation in MSP

activities and workshops, IHE faculty members have numerous opportunities to learn and reflect on the same inquiry-based and hands-on teaching practices as K-12 teachers.

The impact of the MSP on IHE teaching strategies can be significant. The openness and willingness to embrace different modes of practice represents a crucial element in changing the pipeline of teaching practices from K-16. The impact this will have on teaching strategies remains to be seen. One project stated: Using university faculty, both math education and pure math, to do the RTOP observations and conduct PD sessions had a positive impact on both the program and faculty.

In addition to other professional development activities, IHE faculty volunteered their time in other ways. One of the mathematics faculty offered a one-day session on the classroom observation and suggestions. Another faculty volunteered to offer a session on the efficient use of iPads in the classroom. This type of involvement of IHE faculty strengthens the long-term partnership between the university and school district resulting in increased collaboration outside the program. Several participant school districts requested additional summer training and other professional development support. One project commented: "The faculty and staff of our university are offering sustained technical and content support to partner school districts." There is also an increased enrollment of teachers in the programs offered by one university.

The partnering school districts are high-need school districts where more than 25 percent of the students are on free or reduced lunch. Additionally, many participating school districts are rural, isolated school districts with at least one building in school improvement. In the partnership schools, the percentages of students who are economically disadvantaged (as measured by percent of students on Free or Reduced Lunch) range from 27 percent to 100 percent. The percentages of students who are minority populations vary widely from less than one percent to over 84 percent. Similarly, there is wide variation in student achievement levels across the state MSP projects. A substantial portion of MSP schools are not making adequate yearly progress under NCLB.

Each MSP grant has a designated fiscal agent that serves as the lead organization for the project. The fiscal agent is primarily responsible for distributing MSP funds, but often organizes and manages project activities as well. The lead organization is typically an education service cooperative or an IHE but it can also be a local school district.

Table 2.2 describes the number of projects based on lead organization type as well as the mean number of IHE faculty participants by lead organization type. As can be seen in Table 2.2, half of the projects were headed by education service cooperatives and half were headed by institutions of higher education. For all projects, the mean number of IHE faculty participants is 4.25 with a range of 3-7.

Table 2.2

2011-2012 MSP Project Lead Organization Type and Mean Faculty Participants

Type of Organization	Number and Percentage of Projects	Mean Faculty Participants	Range of Faculty Participants
Education Service Cooperative	4 (50.0)	4.25	3-5
Institute of Higher Education	4 (50.0)	4.25	3-7

Note: percentages are in ( ).

The participating IHE faculty was also examined by department. These results can be found in Table 2.3.

Table 2.3

IHE Faculty Participants by Department

Department	Number IHE Faculty
Education	7 (18%)
Mathematics	19 (51%)
Science	2 (5%)
Engineering	3 (8%)
Other STEM Area	5 (13%)
Other	2 (5%)

n = 38

The MSP program establishes local partnerships that include: 1) a science, technology, engineering and/or mathematics department of an institution of higher education and 2) a high-need school district. However, MSP projects may incorporate other types of partners such as: education departments from IHEs; additional local education agencies including public charter schools, public or private elementary or secondary schools; and business and non-profit or for-profit organizations. MSP projects reporting in 2013 had an average of 16 partner organizations

and 11 school districts. As can be seen in Table 2.4, the number of partners ranged from four to 27. The number of school districts ranged from one to 21.

Table 2.4

Number of Participating Partners and Districts

Project Name	Number of Partners N=125	Number of Districts N=89
Common Core Boot Camp	4	1
Getting to the Core	9	7
South Arkansas Mathematics Standards Partnership	21	17
University of Arkansas Engineering & Mathematics Partnership	27	21
6th-8th Grade Algebra Common Core Interactive Initiative	15	13
Math Core Team (MCT)	7	3
6th-8th Grade Geometry Common Core Interactive Project	18	16
Thinking Mathematically for Common Core State Standards in Grades 3-5	24	11

The number of participants involved in MSP professional development across all projects in 2012-2013 was 313. This is 23 participants less than in 2011-2012. In 2012-2013 the number of each project's participants ranged from 21 to 81. Expenditures per participant ranged from $3,231 to $7,502 with the average expenditure being $4,708 in 2012-2013. These results can be seen in Table 2.5.

Table 2.5

Number of Participants and Expenditure per Participants

Project Name	Number of Participants 2011-12 N=336	2012-13 N=313	Projected Expenditure per Participant 2012-13
Common Core Boot Camp	28	21	$7,502
Getting to the Core	40	40	$3,231
South Arkansas Mathematics Standards Partnership	37	40	$4,195
University of Arkansas Engineering & Mathematics Partnership	85	81	$4,327
6th-8th Grade Algebra Common Core Interactive Initiative	42	35	$4,639
Math Core Team (MCT)	30	29	$4,519
6th-8th Grade Geometry Common Core Interactive Project	48	40	$4,083
Thinking Mathematically for Common Core State Standards in Grades 3-5	29	27	$5,171

Table 2.6 reveals the number of teachers by grade level. The largest percent of teachers were middle school (56%). While the target population was grades 3-8, six participants were high school teachers.

Table 2.6
Participants by School Level

Number Elementary Teachers	135 (43%)
Number Middle School Teachers	174 (56%)
Number High School Teachers	6 (1%)

N=313

Table 2.7 reveals the target population and number of students served by each project. The target population for Cohort 6 MSP professional development is classroom teachers in grades 3-8. MSP participants are distributed across school levels in PP13 as follows: 22 percent at the elementary level, 77 percent at the middle school level, and one percent at the high school level. Across all projects, 23,440 students benefited from the MSP.

Table 2.7
Targeted Population and Number of Students Served 2012-2013

Project Name	Targeted Population	Number Elementary Students N=5068	Number Middle Students N=18,012
Common Core Boot Camp	Grades 3-7	614	362
Getting to the Core	Grades 3-5	1016	194
South Arkansas Mathematics Standards Partnership	Grades 3-8	825	420 360HS*
University of Arkansas Engineering & Mathematics Partnership	Grades 6-8	0	12,150
6th-8th Grade Algebra Common Core Interactive Initiative	Grades 6-8	0	1700
Math Core Team (MCT)	Grades 4-6	1700	300
6th-8th Grade Geometry Common Core Interactive Project	Grades 6-8	0	2527
Thinking Mathematically for Common Core State Standards in Grades 3-5	Grades 3-6	913	359

* 360 high school students were also served

All eight projects in Cohort 6 are in their second year of implementation, and are at stage 3 which means they are fully developed, defined as all components of a project's planned model were fully operational.

Attrition

As participation in the MSP program is primarily voluntary, the motivation to continue to participate must be sustained and nurtured throughout the project. Teachers whose interests and needs are served by their participation in the MSP projects will derive greater satisfaction than those whose interests and needs are not met. Some attrition is unavoidable because teachers move out of the district or get reassigned. However, some teachers felt the project required too much time and they were not willing to invest the amount of time required. Overall, projects had very little attrition. One project reported 25% attrition (28 to 21 participants and two projects had an attrition rate of 17% (48 to 40; 42 to 35). One project actually gained participants and one project had the same number both years.

Administrators Involvement

The entire MSP community—project directors, project evaluators, IHEs, teachers, administrators, and educational service cooperatives—can work together to improve professional development. Administrators are often recognized to be a pivotal factor in successful professional development efforts. By interacting with the other members of the MSP community, administrators can examine the goals of the MSP projects and adapt them to meet current school needs and the goals of the school improvement plan. Additionally, administrators can examine the learning models and frameworks of the projects to facilitate the conditions needed to implement the professional development strategies in the classroom.

Section 3:

Teacher Content Knowledge Gains

Research shows that increased teacher content knowledge and pedagogy knowledge lead to improved student achievement (Hill, Rowan, and Ball, 2005; Kilpatrick, et al., 2001; Ball and Bass, 2000, 2003; Grossman, 2008; Goe, 2007; Krauss, Baumert, and Blum, 2008; Fennema and Carpenter, 1996). This section will utilize meta-analysis techniques to evaluate teacher content knowledge gains. Measuring gains in teachers' content knowledge is an important component of federal funding for MSP projects. These gains are expected to be used in the evaluation of the MSP grants. Different numbers of MSP projects have been supported each year in Arkansas. Utilizing individual program effect sizes and meta-analysis techniques provides statistical information to help evaluate the effectiveness of the MSP program in Arkansas.

Increasing Teacher Content Knowledge

As outlined in the MSP theory of action, increasing teacher content knowledge is important to achieving changes in teacher practices. Increased content knowledge makes teachers more comfortable with using many of the strategies advocated by the MSP. Evaluation summaries of the content knowledge seminars were generally positive. Some participants responded that they feel much more comfortable teaching the Common Core, that they had gained confidence in their ability to teach math, and are much more comfortable using technology to teach math in their classrooms.

Across projects Teacher Content Knowledge was analyzed using a meta-analysis. In statistics, a meta-analysis refers to methods that focus on contrasting and combining results from different studies, in an effort to identify patterns among study results or sources of disagreement among those results. In its simplest form, meta-analysis is normally conducted by identifying a common measure of effect size. A weighted average of that common measure is the output of a meta-analysis. For assessing gains in teacher subject matter knowledge, all projects administered a pre- and post-test to measure the difference in teacher content knowledge.

Project directors provided pre- and post-test scores for teachers that were assessed during PP13. Only projects that utilized existing, validated measures and that supplied raw data to the researchers were included in this analysis. The meta-analysis in this report was conducted using Biostat's Comprehensive Meta-Analysis Version 2 software.

Results

In 2012-2013 there were eight mathematics projects. Only projects that utilized existing, validated measures were included in this analysis. One project did not supply raw data; therefore, seven projects were analyzed using meta-analysis. The University of Arkansas Engineering and Mathematics project reported raw scores for three different content knowledge tests and all three are reported. The individual effect sizes (Fisher z-transformation) ranges from -0.102 to .82 and can be seen in Table 3.1 and Figure 3.1. The weighted value of *z* across the projects is .19 which

is considered small. The 95% confidence level ranges from -0.102 to .81. The test for homogeneity was statistically significant (Q = 43.40, df = 8, p = .000).

The effect size is a simple way of quantifying the difference between two groups. Effect size emphasis the size of the difference rather than confounding this with sample size and promotes a more scientific approach to the accumulation of knowledge. Caution should be used when interpreting effect size. Experts argue that the effectiveness of a particular intervention can only be interpreted in relation to other interventions that seek to produce the same effect. In education, if it could be shown that making a small change would raise academic achievement by an effect size of even as little as 0.1, then this could be a very significant improvement, particularly if the effect were cumulative over time. One advantage of using effect size is that when a particular experiment has been replicated the different effect size estimates from each study can easily be combined to give an overall best estimate of the size of the effect (Coe, 2002).

Table 3.1

Meta-Analysis of Cohort 6 2012-2013

Statistics for Each Study							
Study Name	Fisher's Z	Standard Error	Variance	Lower Limit	Upper Limit	z	P
6-8 Grade Algebra	-0.102	0.049	0.002	-0.108	0.085	0.237	0.813
6-8 Grade Geometry	-0.093	0.063	0.004	-0.030	0.216	1.475	0.140
Common Core Boot Camp	0.816	0.134	0.018	0.554	1.079	6.090	0.000
SAU Math Partnership	0.397	0.096	0.009	0.210	0.585	4.152	0.000
UAE-Numbers	0.089	0.093	0.009	-0.093	0.272	0.958	0.338
UAE-Algebra	0.100	0.053	0.003	-0.004	0.205	1.880	0.060
UAE-Probability	0.154	0.049	0.002	0.058	0.249	3.152	0.002
Math Core Team	0.347	0.079	0.006	0.192	0.501	4.405	0.000
Getting to the Core	1.311	0.121	0.015	1.073	1.548	10.814	0.000
Combined	0.186	0.023	0.001	0.142	0.231	8.219	0.000

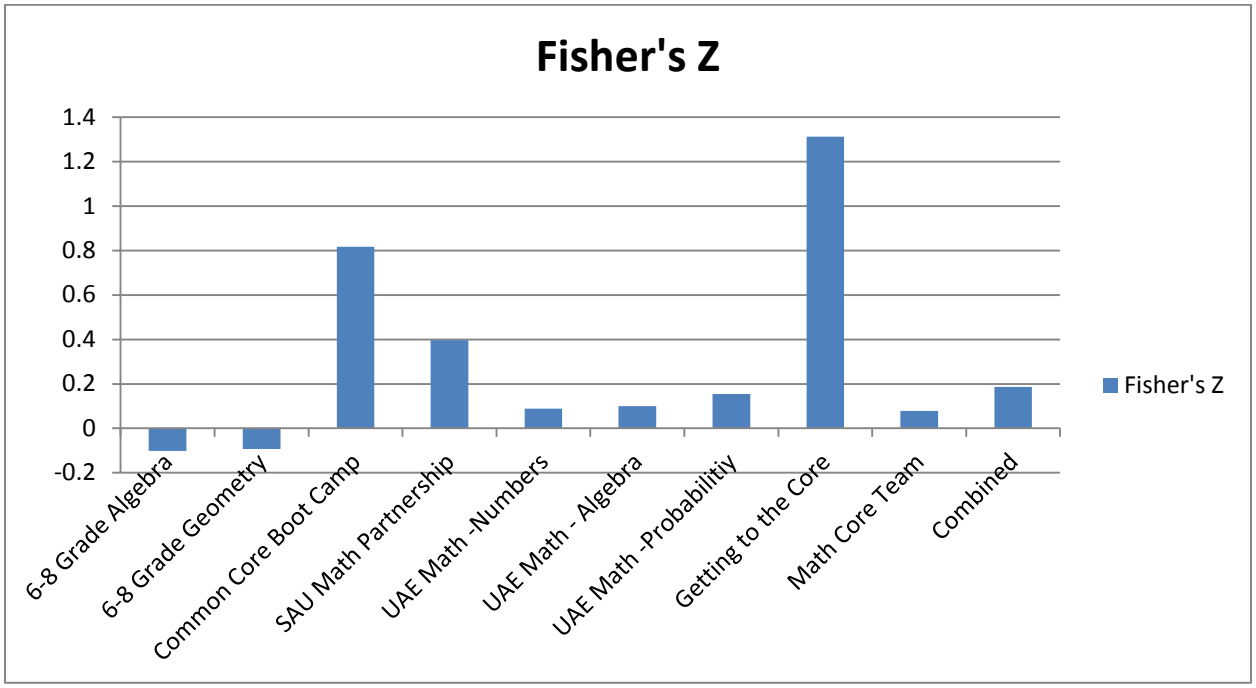


Figure 3.1: Meta-Analysis

In the MSP, the professional development activities are essential to ensuring that teachers not only understand how to change instructional practices, but why such changes are important. Awareness of the larger purpose behind these changes is a critical component of sustainability, as it provides teachers with a foundation that should last beyond the funding period of MSP. Six projects reported statistics on teachers with significant gains in content knowledge. As detailed in Table 3.2 and Figure 3.2, percent of teachers with significant gains ranged from 0 percent to 95 percent.

During the second year six out of eight projects saw a statistically significant increase in some participants' content knowledge. Although two projects did not show any participants with significant improvement in teacher content knowledge, this does not necessarily mean that no participants in those projects gained content knowledge. It could be that the test they chose to use to measure content knowledge may not have been an accurate measure of the content covered in the professional development.

When considered independently not all project showed a statistically significant increase in teacher content knowledge but when all projects are considered together the results are statistically significant.

Table 3.2

Percent of Teachers with Gains in Content Knowledge

Project	Total Number of Teachers Served		Number of teachers with content assessments		Percent of Assessed Teachers with Significant Gains	
	2012	2013	2012	2013	2012	2013
6th-8th Grade Algebra Common Core Interactive Initiative	42	35	37 (88%)	30 (86%)	26 (70%)	0 (0%)
6th-8th Grade Geometry Common Core Interactive Project	48	40	42 (88%)	40 (100%)	22 (52%)	17 (43%)
Common Core Boot Camp	25	21	19 (76%)	20 (95%)	14 (74%)	19 (95%)
Getting to the Core	40	40	40 (100%)	39 (98%)	30 (75%)	14 (36%)
Math Core Team (MCT)	30	29	27 (90%)	22 (76%)	14 (52%)	15 (68%)
South Arkansas Mathematics Standards Partnership	37	40	31 (84%)	31 (80%)	17 (55%)	20 (69%)
Thinking Mathematically for Common Core State Standards in Grades 3-5	29	27	No post test	27 (100%)	NA	23 (85%)
University of Arkansas Engineering & Mathematics Partnership	85	81	75 (88%)	63 (78%)	Did Not Report	0 (0 %)

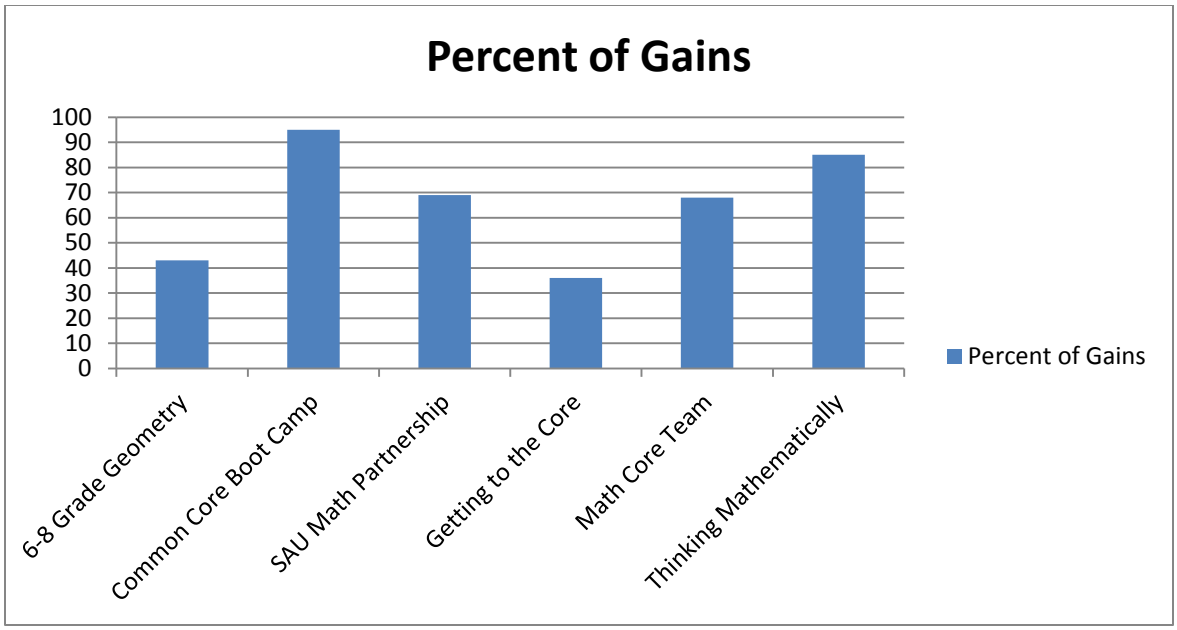


Figure 3.2: Percent of Teachers with Significant Gains

Pedagogical Practice

In addition to teacher content knowledge gains, projects also conducted Reformed Teaching Observation Protocol (RTOP) visits to the partnership schools. RTOP was created by the Evaluation Facilitation Group (EFG) of the Arizona Collaborative for Excellence in the Preparation of Teachers (ACEPT). RTOP was developed as an observation instrument to provide a standardized means for detecting the degree to which K-16 classroom instruction in mathematics or science is reformed. EFG developed RTOP from two instruments: the Horizon Research Inc. instrument and a classroom observation instrument developed locally by ACEPT co-PI Dr. Anton Lawson (1995) of ASU Biology Department.

RTOP is organized into five categories including and includes five items in each category. Categories include::

1. Lesson design and implementation
2. Content: propositional pedagogic Knowledge
3. Content: Procedural Pedagogic Knowledge
4. Classroom Culture: Communicative Interactions
5. Classroom Culture: Student/teacher Relationships

Observation of teaching was conducted by a trained RTOP observer who visited the participant's classroom. The participant was rated using the RTOP which allows a trained observer to characterize the degree to which faculty implement active-learning teaching techniques in their courses. The RTOP defines and allows the assessment of learner-centered teaching and is aligned with the theoretical underpinnings of inquiry-based teaching. The RTOP is a highly reliable instrument with strong predictive validity for student achievement.

An RTOP score is an indicator of the degree of active-learning instruction and student involvement observed in a classroom. A final score is obtained by summing five subscales, which quantitatively rate an instructor on the five categories. RTOP scores range from 0 to 100, with higher scores representing more learner-centered classrooms (i.e. students actively participate, take primary responsibility for their own learning, interact with each other, and shape the direction of the discussion), whereas lower scores indicate lecture-based, teacher-centered classrooms. Teachers were not observed prior to participating in the professional development so projects used the initial visit after professional development as baseline data.

Table 3.3
RTOP Data 2012 and 2013

Project	Year 1 -- 2012			Year 2 -- 2013		
	N	Mean	SD	N	Mean	SD
6^{th} – 8^{th} Grade Algebra	41	50.57	12.84	41	60.94	7.70
6^{th} – 8^{th} Grade Geometry	42	60.97	11.90	42	66.93	12.97
Common Core Boot Camp	21	35.52	7.77	20	39.15	4.54
Math Core Team	11	10.18	3.55	22	14.73	5.52
Getting to the Core	Did not report			Did not observe		
South Arkansas Mathematics Partnership	26	60.44	12.68	26	78.51	14.89
Thinking Mathematically	18	26.71	6.29	18	68.3	15.67
UA Engineering and Mathematics Partnership	72	50.33	15.44	70	65.20	12.71

While projects were asked to submit the data by item scores and the summary scores for each of the five categories this did not happen. Below is what each project submitted.

Getting to the Core

Using RTOP, the PI and co-PI of the project observed a math lesson taught by all MSP teachers in Year 1, Spring of 2012. RTOP is a 25-item classroom observation protocol to measure how well math or science instruction is aligned with reformed teaching. The project staff is planning to observe all MSP teachers at the end of Year 3, which no RTOP scores in Year 2. One teacher was added during year 2, and the PI completed an RTOP observation for her during year 2. One additional teacher was added to the group at the end of year 2. The PI is planning to visit and score her teaching in Fall of 2013 for baseline data, in place of pre-test score.

University of Arkansas Engineering and Math Partnership (UA-EMP)

As in previous year, five of the project staff visited 70 classrooms to observe a class and collect Reformed Teaching Observation Protocol (RTOP) data. For the early visits, staff went in pairs, and after they got more familiar with using the RTOP scale, staff visited classes individually. On the RTOP scores range from 0 to 4 on each of 25 items, with a possible range of 0 to 100.

Results. For the teachers observed in Year 1, scores ranged from 20 to 83, with a mean 50.33 (SD = 15.44) for 72 observations. In Year 2, scores (based on 70 observations) ranged from 33 to 90, with a mean 65.20 (SD = 12.71). Therefore, the average RTOP scores have increasing 14.87 points, which indicated there were changes in teachers' instructional practices. Although the comparison between Year 1 and Year 2 violated independence assumption, the independent t-test result was significant, t (140)=6.26, p<.001.

The South Arkansas Mathematics Standards Partnership

To document changes in the project's participant's teaching practices the Reformed Teaching Observation Protocol was employed. The **Reformed Teaching Observation Protocol (RTOP)** was developed as an observation instrument to provide a standardized means for detecting the degree to which K-20 classroom instruction in mathematics or science is reformed. Project staff and the project's external evaluator were trained on using RTOP during the summer of 2011 in a multi-day session facilitated by one of the original developers of RTOP.

Twenty-six of the project's participants have been observed and RTOP completed on four occasions: fall 2011, spring 2012, fall 2012, and spring 2013. The same rater observed each participant on each of the four occasions.

Because the repeated observations are not independent of each other individual difference scores were computed for the consecutive evaluations. That is difference between F2011 and S2012, the difference between S2012 and F2012, the difference between F2012 and S2013, and the difference between F2011 and S2013. These four differences are henceforth referred to as Delta1, Delta2, Delta3, and Delta.

One tailed t-tests on these differences were performed (alternate hypotheses of a mean difference that is greater than zero). The results, p-values, and Cohen's d values are shown in the table below. All sample sizes are n = 26 meaning t-test' p-values are computed with df = 25. All p-value computations were done with the statistical software package R.

Statistic	Mean	Standard Deviation	T	P-value	*d***
Delta1	3.315	13.851	1.404	.0863	.389
Delta2	3.741	17.175	1.111	.1386	.309
Delta3	10.519	13.807	3.884	.0003*	1.077
Delta	18.074	20.679	4.457	.00008*	1.236

* The p-value is considered "highly statistically significant".

** The interpretation of Cohen's *d* is that the threshold for s "small" effect size is .2, the threshold for a "medium" effect size is .5, and the threshold for a "large" effect size is .8.

The results of this analysis show that to this point the project's activities have been highly effective in altering participant's teaching practice into that which is generally accepted in the K-20 education community as "reformed teaching". Reform signals a paradigm shift from the traditional teacher-centered lecture-driven class to a student-centered, activity-based learning environment that typically includes multiple opportunities for collaboration among students.

Reformed teaching emerged from the principles of effective teaching introduced in 1988 by the American Association for the Advancement of Science's report on the state of science teaching in American educational institutions, Project 2061: Science for all Americans (AAAS, 1989).

These principles state that teaching should:

- Be consistent with the nature of science inquiry
- Reflect scientific values
- Aim to counteract learning anxieties
- Extend beyond the school

Take its time.

Math Core Team

During Year 1, STEM faculty visited the classrooms of 11 of the treatment-group teachers to assist with planning and revisions of the workshop content and used the Reformed Teaching Observation Protocol (*RTOP*) comprised of lesson, content, and culture scales to record observations. During Year 2, STEM faculty visited the classrooms of all participating teachers during the fall semester who were not visited during the Year 1 and again used the *RTOP*. For lesson, results from an independent samples *t* test revealed a statistically significantly higher scores from teachers in Year 2 ($M_2 = 14.73$, $SD_2 = 5.52$) than in Year 1 ($M_1 = 10.18$, $SD_1 = 3.55$) [$t(28.80) = 2.89$, $p = .008$, *Cohen's d* = 0.69]. For content, results from an independent samples *t* test revealed a statistically significantly higher scores from teachers in Year 2 ($M_2 = 28.82$, $SD_2 = 9.90$) than in Year 1 ($M_1 = 19.09$, $SD_1 = 6.40$) [$t(28.70) = 3.40$, $p = .002$, *Cohen's d* = 1.08]. For culture, results from an independent samples *t* test did not reveal a statistically significantly difference between scores from teachers in Year 2 ($M_2 = 29.14$, $SD_2 = 10.54$) than in Year 1 ($M_1 = 26.64$, $SD_1 = 5.03$) [$t(31) = 0.74$, $p = .464$, *Cohen's d* = 0.28].

6th – 8th Grade Algebra

A new source of qualitative evaluation has been added to the MSP Algebra project in Year II. This source is data obtained from the RTOP. The RTOP (Reformed Teaching Observation Protocol) is used to measure the degree of reform teaching that is used during a lesson. For the purpose of this project, the project received training from the RTOP online training course. The Project Director and External Evaluator attended RTOP training at Harding University in September, 2012. The RTOP observers then made a fall, 2012 and spring, 2013 RTOP observation visit to the classrooms of MSP participants who were active in the fall, 2012 and spring, 2013 Year II project. The RTOP observation form was incorporated as an app on iPads, which became a method to electronically transfer the completed RTOP to the internal

evaluator housed at Harding University. The observation assessed the participants' teaching of a Common Core Algebra lesson.

This Year II RTOP evaluation process is subjective in nature. The training instructors were using the RTOP format for the first time in the fall, 2012 and the MSP participants did not have much information about the RTOP items they were being rated on during the classroom visits. Furthermore, there was little or no debriefing between the fall, 2012 and spring, 2013 RTOP classroom visits. The debriefing of the RTOP results was not formally discussed with the MSP participants until the June, 2013 Summer Institute sessions.

Therefore, in the opinion of the external evaluator, even though we can compare the Year II fall, 2012 and spring, 2013 data, the results of the RTOP will best be analyzed when the project can compare Year II (2012-2013) results against Year III (2013-2014) results. That said, the Year II RTOP data was analyzed and provides us with the following results. The data on MSP participants who completed Year II through the spring, 2013, is meaningful as illustrated in the following charts. In summary, it indicates:

- MSP Participants With Increase: 30
- MSP Participants With No Change: 7
- MSP Participants With Decrease: 4

6^{th} – 8^{th} Grade Geometry

A new source of qualitative evaluation has been added to the MSP Geometry project in Year II. This source is data obtained from the RTOP. The RTOP (Reformed Teaching Observation Protocol) is used to measure the degree of reform teaching that is during a lesson. For the purpose of this project, the project received training from several sources. Three university professors attended a University of Arkansas-Fayetteville RTOP training during Year I (2011) sponsored by the Arkansas Department of Education. The fourth university instructor, as well as the other three, attended an RTOP training at Harding University, IHE partner, in Year II, September, 2013.

The university instructors then made a fall, 2012 and spring, 2013 RTOP observation visits to the classrooms of MSP participants who were still active in the Year II project at this point in time. The RTOP observation form was incorporated as an app on iPads, which became a method to electronically transfer the completed RTOP to the internal evaluator housed at Harding University. The observation assessed the participants' teaching of a Common Core Geometry lesson.

This Year II RTOP evaluation process is subjective in nature. The university instructors were using the RTOP format for the first time in the fall, 2012 and the MSP teachers/participants did not have much information about the RTOP items they were being rated on during the classroom visit. Furthermore, there was little or no debriefing between the fall, 2012 and the spring, 2013 RTOP classroom visits. The debriefing of the RTOP results was not formally discussed with the MSP participants until the June, 2013 Summer Institute sessions. Therefore, in the opinion of the external evaluator, even though we can compare the Year II fall, 2012 and

spring, 2013 data, the results of the RTOP will best be analyzed when the project can compare Year II (2012-2013) results with Year III (2013-2014) results.

That said, the Year II data was analyzed and provides us with the following results.

The data on MSP participants who completed Year II through the spring, 2013, is meaningful as illustrated in the following charts. In summary it indicates:

- MSP Participants With Increase: 29
- MSP Participants With No Change: 2
- MSP Participants With Decrease: 11

Common Core Boot Camp

Observations: The Reformed Teaching Observation Protocol (RTOP) was developed as an observation instrument to provide a standardized means for detecting the degree to which K-20 classroom instruction in mathematics or science is reformed. The Reformed Teaching Observation Protocol (RTOP) was created by the Evaluation Facilitation Group (EFG) of the Arizona Collaborative for Excellence in the Preparation of Teachers (ACEPT). The following information was obtained from the RTOP technical manual (ACEPT Technical Report IN00-3). "It is an observational instrument designed to measure "reformed" teaching. It still consists of 25 items divided into three subsets: Lesson Design and Implementation (5), Content (10), and Classroom Culture (10).

The second and third subsets are each divided into two smaller groups of five items. The first subset, was designed to capture what had become the ACEPT model for reformed teaching. It describes a lesson that begins with recognition of students' prior knowledge and preconceptions, that attempts to engage students as members of a learning community, that values a variety of solutions to problems, and that often takes its direction from ideas generated by students. The second subset was directed at content, and was divided into two parts. The first assessed the quality of the content of the lesson, and the second attempted to capture the ACEPT understanding of the process of inquiry. The final subset, consisting of ten items, was directed at the climate of the classroom." A paired t-test will be used to compare scores on each of the subscales from the beginning of the year to scores at the end of the year.

A trained observer from the Center for Community Engagement visited each participant teacher 1-2 times in the Fall semester and 1-2 times for the Spring semester. The goal was to observe each teacher four times; however, various difficulties prevented this goal from being achieved for all teachers. The RTOP protocol is divided into several sub-scales. Each scale has a different number of items. All items are rated on a Likert-type scale ranging from *0* (never occurred) to *4* (very descriptive). Table 4 presents the mean for each sub-scale during the Fall and Spring semester.

Table 4 ***RTOP observation means, Fall 2012 and Spring 2013 (N = 20) Subscale***	***Fall 2012 observation Mean (SD)***	***Spring 2013 observation Mean (SD)***	***T test and p value***
Lesson Design and Implementation	1.2 (0.3)	1.1 (0.3)	t (19)=1.06 p>.25
Propositional Knowledge*	1.7 (0.2)	1.9 (0.2)	t (19)=-2.05 p=<.05 *
Procedural Knowledge*	1.7 (0.4)	1.5 (0.3)	t (19) =2.98 p<.01 *
Communicative Interaction	1.2 (0.3)	1.2 (0.2)	t (19)=-.26 p>.50
Student/Teacher Relationships*	1.4 (0.4)	1.7 (0.4)	t (19) =-3.22 p<.01 *

Note: * Significant change from pre-testing to post-testing; paired-samples t-test, N=20; $p \leq .05$.

Results from a series of paired samples t-test reveal that: Improvement was shown in the Propositional Knowledge subscale (e.g., the lesson promoted conceptual understanding, connections with real-world phenomena were explored). The increased scores in Propositional Knowledge indicate teachers are doing a slightly better job connecting material to real life situations and relating the material to multiple disciplines. Somewhat surprisingly, a decrease was found in the Procedural Knowledge subscale (e.g., students represented solutions in multiple ways, students were reflective about their learning). Lower scores in Procedural Knowledge indicate that teachers need to continue working on their ability to allow students to use different methods to find and represent solutions.

Improvement was also shown in the Student/Teacher Relationships subscale (e.g., active student participation was encouraged, the teacher acted as a resource person). Higher scores in Student/Teacher Relationships show that across the school year teachers became slightly more patient and were encouraging student investigation a little more.

No pre-post differences were found for Lesson Design and Implementation (e.g., lessons designed to engage students as a learning community, student exploration preceded formal presentation) or for communicative Interactions (e.g., teacher's questions triggered divergent

Thinking Mathematically

In Spring 2012 and 2013, a trained observer observed participants in their classrooms as they delivered a 20-minute lesson on a topic of their choice related to material covered by the Common Core State Standards for grades 3-6. The observer used the Reformed Teaching Observation Protocol (RTOP) to assess the instruction. The average RTOP score for all participants reviewed in Year 1 was 26.7 (SD 6.3) compared to 68.3 (SD 15.7) in Year 2. **Table 4** includes subscale scores for all participants in

Years 1 and 2. No statistical comparison is provided since only five participants were included in the Year 1 observation. Full results are included in the Appendix.

Table 4. Mean Participant RTOP Subscale Scores, Years 1 and 2

Subscale	Year 1 Mean (SD)	Year 2 Mean (SD)
Lesson Design and Implementation	1.0 (0.4)	2.8 (0.7)
Propositional Knowledge	1.5 (0.2)	2.9 (0.8)
Procedural Knowledge	1.0 (0.3)	2.5 (0.9)
Communicative Interaction	0.8 (0.3)	2.5 (0.6)
Student/Teacher Relationships	1.2 (0.4)	3.1 (0.7)

Changes in Instructional Practices

Effective professional development activities should lead to changes in instructional practices. Changes in instructional practices, particularly sustainable ones, depend on many factors. The logic model highlights some important short- and mid-term outcomes that contribute to teachers' ability to engage in classroom practices that enhance K-12 students' knowledge of mathematics and science. Some of these outcomes should be evident at the classroom level, such as increased awareness and knowledge of research-based instructional practices and materials and increased teacher content knowledge. Other outcomes are targeted at the school and/or district level, including changes in policies and practices and alignment of curriculum with professional development and state standards, all of which can contribute to and support teachers' efforts to change instructional practices.

Although it is not possible to fully evaluate whether the MSP has fostered changes in instructional practices, as reported in the previous section, participants RTOP scores suggest participants instructional practices are changing. In addition, participants report changes they made in the past year as a result of the MSP professional development. Some comments include:

- I really enjoy being in this grant project. I have learned to look at math in a different way. This project has really helped me plan my lessons and bring the content to my students in a more developmental way. There were several lessons that I took from this project into my classroom last year and they were very insightful as to how my students approach geometry.
- In year's past I have read the Hershey's book about fractions with my students and they always seem to enjoy it. This year I taught Salem's 5E lesson plan that went with the book and the kids loved it! I used a large Hershey bar on the overhead with my class and placed students in small groups to come to the board and create fractions from the various pieces. We talked about equivalent fractions and the Hershey bar was a great tool because they could visualize the idea of sameness. After the lesson I passed out fun size bars the kids were

making fractions with their own bars before eating. I will definitely do this lesson again with my students."

- Oh after testing it seemed like forrrrever before school would be out! What a perfect time to try some of the activities we've acquired in Bootcamp right? Well, I did just that! The students absolutely loved them, although they said they were very challenging. One of their favorites, The Unusual Baker. Again, I thought it would be too hard for 3rd graders. But, I had some very motivated students that enjoyed a challenge. Everyone got Monday, and Tuesday, Wednesday started to become difficult for some. Thursday and Friday were problem solvers. Again, I let them work in groups and the struggling learners seemed to be involved with the activity. Many of the mathematical practices in this lesson, especially make sense of problems and PERSEVERE in solving them.
- I used some of the activities we learned at Bootcamp last year too. I hung a clothes line and had t shirts made at the Coop. I wrote a variety of fractions on the t shirts and had the kids hang the shirts were they thought they would go. It was very eye opening. Once the shirts were hung, we got out the fraction tiles and looked at 1/3 compared to 1/2, etc. The kids were able to look at the line and find the shirts they had in the wrong place. I left the lineup after that to help them with fractions. I had been teaching fractions for awhile, but this activity really opened my eyes to who understood and who did not.
- I am beginning to be more of a student centered teacher. I am also more aware of the types of questions that I ask in the classroom.

The MSP program emphasizes increasing subject matter knowledge for mathematics and science teachers as a means of improving teaching and student achievement. However, to guide student thinking that results in improved achievement, teachers must also understand how children's ideas about a subject develop. As a result, all projects integrated pedagogical knowledge components into their projects.

Features common to all of the projects were an emphasis on teachers' essential role in designing mathematical lessons and activities, predicting trouble areas for students, understanding student misconceptions, and determining what students know.

Projects frequently structured activities to allow for group interaction. Participants were given the opportunity to learn pedagogical knowledge through hands on activities and were encouraged to work together in ways that would be similar to how they might incorporate the activities in their own classes. This format was appealing to the participants because it allowed them to learn, think about, and practice new instructional strategies while collaborating with their peers, thereby making the structure of the workshops more interactive and enjoyable.

Six of the eight projects conducted pre- and post-test comparisons with treatment and control group. For those projects that conducted both pre and post tests for the treatment and control groups, four projects reported a significant difference in treatment group scores but no difference in control group scores.

Section 4:

Student Outcomes

Title II-B, Mathematics and Science Partnerships (MSP), is intended to increase the academic achievement of students in math and/or science by enhancing the content knowledge and pedagogical skills of classroom teachers. This imperative is reflected in the goals of the partnership, one of which is to increase K-12 students' knowledge of mathematics and science. Ultimately, our assessment of student learning seeks to measure changes in student outcomes. The bottom line for the MSP is to demonstrate improved student learning in mathematics and science.

Measuring Student Achievement

The most common measure of student outcomes used by the projects is the Arkansas Benchmark Exam. Based on scale scores, the Arkansas Benchmark Exam is a standards-based, criterion-referenced and norm-referenced assessment used to measure students' attainment of Arkansas academic standards. Beginning in 2007-2008, the Benchmark Exam was combined with the Stanford Achievement Test, Tenth Edition (SAT-10 or Stanford 10) to create the Augmented Benchmark Examination.

Traditionally, the Arkansas Augmented Benchmark Assessment is administered to students in grades 3-8. Four performance-level descriptors are used for the ABE: advanced level reflects superior academic performance, proficient reflects satisfactory academic performance, basic reflects marginal academic performance, and below basic inadequate academic performance.

Educational literature suggests that teachers' intellectual resources significantly affect student learning. Demonstrating that professional development leads to gains in student achievement poses a number of challenges, despite an intuitive and logical connection. Professional development affects student achievement through three steps. First, professional development enhances teacher knowledge and skills. Second, better knowledge and skills improve classroom teaching. Third, improved teaching raises student achievement. All links must be present for student learning to take place (REL, 2001).

Table 4.1 summarizes the 2012-2013 benchmark results for the eight projects. Data for the percentages of Below Basic and Basic versus Proficient and Advanced are given. For two of the projects these data were not reported.

Table 4.1
Student Benchmark Results

Project	Number of Students	Below Basic/ Basic	Proficient/ Advanced
Mathematics Core Team			
2012	375	81 (22%)	294 (78%)
2013	723	94 (13%)	629 (87%)
South Arkansas Math Standards Partnership			
2012	907	209 (23%)	698 (77%)
2013	1079	248 (23%)	831 (77%)
U of A Engineering and Math Partnership			
2012	4926	1129 (23%)	3797 (77%)
2013 – Did not Report	--	--	--
Thinking Mathematically			
2012 – Did not Report	---	---	---
2013	1272	193 (15%)	1079 (85%)
6^{th}-8^{th} Grade Algebra			
2012	1443	354 (25%)	1089 (75%)
2013	1400	379 (27%)	1021 (73%)
6^{th}-8^{th} Grade Geometry			
2012	1384	254 (18%)	1130 (82%)
2013	1140	316 (28%)	824 (72%)
Getting to the Core			
2012	1333	213 (16%)	1120 (84%)
2013	1104	213 (19%)	891 (81%)
Common Core Boot Camp			
2012	750	104 (14%)	646 (86%)
2013	976	115 (12%)	861 (88%)

At the state level, 75% of students scored at the Proficient or Advanced level. When comparing project benchmark scores to the overall state benchmark scores, two projects scored slightly less than the state average. For 2013, the percentages ranged from 72% to 88% and four of the eight projects had benchmark scores above 80%.

Caution should be used in interpreting these results. Year-to-year comparisons on these benchmarks are problematic because they compare different cohorts of students. In addition the benchmarking results are a relatively simplistic way to assess project impact because they cannot distinguish between changes that occur due to the MSP project versus changes due to other independent forces that are causing general statewide improvements in student proficiency levels.

Projects analyze and report student data in different ways. From a statewide evaluation perspective, these inconsistencies are problematic. While MSP guidelines are clear, individual

project directors and evaluators are not consistent in their reporting. For example, some report test scale scores, categorical data, or raw data. Therefore, we are including what each project actually reported for analyzing student data.

Mathematics Core Team

Students' benchmark mathematics subscores from 2012 and 2013 were obtained from eight treatment-group teachers. In total, data were obtained for 154 students. The average score for students in 2012 was *562.37 (SD=112.14*) and in 2013 was *594.81 (SD=101.16)* Results from a dependent samples *t* test revealed a statistically significant gain in students' scores *[t(153) = 6.72, p<.001, Cohen's d=0.54]*.

Posttest student data (2013 Benchmark mathematics subscores) were obtained from all 31 treatment-group teachers (M_t =643.84, SD_t = 103.94, N_t =1005) and from 27 comparison-group teachers (M_c = 632.59, SD_c = 105.59, N_c = 1023). Results from Levene's Test indicated that the homogeneity of variance assumption was reasonable [f(1004, 1022)=3.33, p=.068] and results from an independent samples t test revealed a statistically significantly higher scores for students in the experimental teachers' classrooms *[t(2026) = 2.42, p=0.16, Cohen's d =0.11]*.

South Arkansas Mathematics Standards Partnership

ACTAAP (Arkansas Comprehensive Testing, Assessment, and Accountability Program) examination results were provided to project staff by twenty-two of the project's participants. These are the participants whose instructional duties are those of a "regular" classroom teacher. A total of n=1,079 students' results were reported.

As the ACTAAP examination is a criterion referenced examination the ultimate score reporting is done categorically as Below Basic, Basic, Proficient, or Advanced. For this year's results 75 students (7%) were reported as Below Basic, 173 (16%) were reported as Basic, 561 (52%) were reported as Proficient, and 270 (25%) were reported as Advanced.

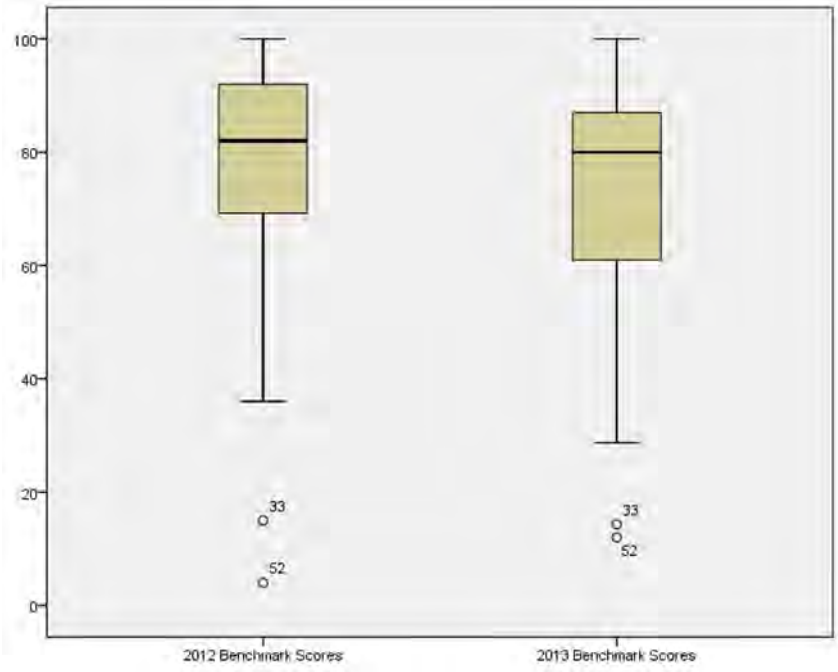
When considered globally these results are consistent with Arkansas's overall results for 2012-2013. These are the data that are given in the student achievement section of the GPRA section of the annual report

UA Engineering and Mathematics Partnership

Year 1 (2011-2012) of the project had been settled as the baseline year. To assess the effectiveness of the program on student achievement, we used 2012 student test scores as our baseline and compared with 2013 test scores. In addition, we plan to do a longitudinal comparison, which means the mean scores of participants' students from the baseline year were compared to the mean scores of their students this year (Year 2) and would be compared with Year 3 as well.

A paired-sample *t* test was conducted to evaluate the effectiveness of the program on student achievement (i.e., Benchmark scores). The results indicated the mean on student 2012 Benchmark scores (M = 76.92, SD = 20.40) was significantly greater than the mean on student 2013 Benchmark scores (M = 73.61, SD = 20.06), t (60) = 3.03, p = .004. The standardized effect

size index, *d*, was .39, with considerable overlap in the distribution as shown in below. The 95% confidence interval for the mean difference between two years was 1.127 to 5.500. In general, the 2013 cohort's achievement was worse than the 2012 cohort's performance in benchmark test. This decrease was expected as the 2013 curriculum was the Common Core but the students were tested on the old Arkansas Frameworks. If teachers were implementing Common Core as the program desired, we fully expected the students' scores to decrease.



Thinking Mathematically

Expected Outcome: students of 50% of teachers in the professional development group will meet or exceed the district's annual goal for percentage increase in proficiency on the 2012-2013 mathematics benchmark exam.

Expected Outcome: students of teachers in the professional development group will have statistically significant higher rates of proficiency on the mathematics benchmark examination compared to the control group at the end of each year that includes professional development activities

The 27 participant teachers instructed 1,272 students who completed the state assessments in mathematics, and the project team obtained data for all participant teachers. Of the 23 control teachers who began the year, student data was available for 21 teachers who taught 805 students who completed the state assessment. No significant differences were noted between groups with 84.8% of participants' students and 84.0% of controls' students performing at the proficient or advanced levels. Data on teachers meeting or exceeding the districts' annual goals for percentage increases in proficiency were incomplete

6th-8th Grade Algebra

Participants: MSP Participants (N=29) Students (N=1,400)

Instrument: Arkansas ACTAAP Benchmark Mathematics Tests 2012-2013
Results: The accompanying charts provide a grade level breakdown of the Arkansas Mathematics Benchmark scores for each MSP participant's Algebra students.
The results were collected in July/August, 2013, once local school districts received, analyzed and released the data and student scores for the MSP project evaluation and Year II Annual Performance Report (APR).

BREAKDOWN OF 2012-2013 SAT-10 AND BENCHMARK SCORES

Grade	# of MSP Teachers With Data	Total # Students	SAT-10		BENCHMARK			
			Below 50%	Above 50%	Below Basic	Basic	Proficient	Advanced
4	3	82			1	11	26	44
5	7	355	0	19	36	78	135	78
6	4	147			3	15	73	90
7	5	188			29	46	75	38
8	10	628	5	19	78	77	240	184
TOTALS	29	1,400	5	38	147	227	549	434

6th-8th Grade Geometry

STUDENT ACHIEVEMENT – YEAR I

Participants: MSP Participants (N=20) Students (N=1140)Instrument: Arkansas ACTAAP Benchmark Mathematics Tests (2012-2013) Results: The accompanying charts provide a grade-level breakdown of the Benchmark scores for each MSP participant's Geometry students.

Wilbur D. Mills Co-op MSP
Grade Level Breakdown of 2012-2013 Benchmark Scores

GRADE	# OF MSP TEACHERS WITH DATA	TOTAL # STUDENTS	BELOW BASIC	BASIC	PROFICIENT	ADVANCED
5	1	43	12	7	21	3
6	3	251	14	36	101	90
7	2	73	6	13	38	14
8	10	572	91	98	259	120
9	4	201	10	29	86	79
TOTALS	20	1140	133	183	505	306

Getting to the Core

Teachers in the MSP and control group were asked to submit students' mathematics achievement data on the AR state benchmark tests in 2011-2012 school year and 2012-2013 school year. They were asked to submit the number of students in each category including: Below Basic/Basic and Proficient/Advanced. Thirty-two of the 39 teachers in MSP group and 35 of the 37 teachers in the comparison group submitted the student data for 2012-2013 year assessment.

The analysis of student data indicates that there is no difference between the Year 1 and Year 2 student data in the MSP teacher group, and there is no statistical difference from the MSP group to the comparison group. It appears the performance of the students in the project districts overall is already very high with 80+% of students scoring advanced/proficient. The students' performance might be hitting a ceiling with regards to the percentage of students scoring proficient or advanced on the state benchmark exams.

Common Core Boot Camp

Impact on student content knowledge was assessed in two ways. Scores on state mandated tests end of year tests were obtained from participant teachers and results are presented below:

Number of students	Number (%) scoring below basic	Number (%) scoring at basic	Number (%) scoring at proficient	Number (%) scoring advanced
976	24 (3%)	91 (9%)	304 (31%)	552 (57%)

Students of participating and comparison group teachers were administered a content test developed by grant personnel, focusing on ratios and fractions. Tests were grade appropriate; students at each grade completed a different version of the test. Students completed the test at the beginning and the end of the academic year. Tests were multiple choice, and scores were summed, ranging from 0 – 25. Only students with scores at both time points were included in the following analyzes. First, test scores between students in participating teachers' classrooms and comparison teachers' classes were compared using an independent t-test. The only significant difference was obtained for grade 6; students in the comparison group scored significantly higher than students in the participating teachers' classrooms for the pre-program assessment.

Next, group scores for participating classrooms were analyzed using a paired t-test to examine differences at the beginning of the academic year and at the end. As Tables 6 and 7 reveal, all classes (both participating teachers and comparison group teachers) had significantly higher mean scores on the content test at the end of the academic year compared to the beginning of the year.

Content scores for students in participating teachers' classrooms

Grade	Number of Students with pre and post test scores	Mean score (SD) beginning of academic year	Mean score (SD end of academic year	t test value	p value
3rd	130	17.1 (4.6)	20.4 (3.9)	8.7	.000
4th	84	16.0 (4.6)	18.7 (4.5)	6.1	.000
5th	50	17.1 (4.3)	19.4 (3.8)	5.0	.000
6th	15	13.3 (4.9)	16.3 (4.9)	3.2	.006
7th	33	15.2 (3.3)	16.4 (4.1)	2.0	.056

Content scores for students in comparison teachers' classrooms

Grade	Number of students with pre and post test scores	Mean score beginning of academic year	Mean score end of academic year	t test value	P value
3rd	101	171.8 (4.3)	20.9 (3.2)	8.3	.000
4th	128	15.5 (4.9)	18.5 (4.6)	7.8	.000
5th	38	17.9 (6.0)	20.2 (4.2)	3.6	.001
6th	31	16.4 (3.0)	17.6 (3.4)	2.01	.053
7th	32	15.2 93.5)	18.2 (3.2)	4.8	.000

Individual student scores for each grade were analyzed using dependent t-test, in order ascertain the number of students with significant gains at each grade. As Tables 8 and 9 reveal, again, similar patterns are seen between the students in the participating teachers' classrooms and students in the comparison teachers' classrooms.

Students in participating teachers' classrooms

Grade	Number of students with pre and post test	Number of students with significant gains (%)	t test value	p value
3rd	130	87 (67%)	8.9	.000
4th	84	52 (62%)	6.2	.000
5th	50	28 (56%)	5.0	.000
6th	15	11 (73%)	2.6	.005
7th	33	16 (49%)	2.0	.028

Students in comparison teachers' classrooms

Grade	Number of students with pre and post test scores	Number of students with significant gains (%)	t test value	p value
3rd	101	67 (66%)	8.4	.000
4th	128	82 (64%)	7.8	.00
5th	38	20 (52%)	3.6	.000
6th	31	20 965%)	2.1	.026
7th	32	20 (63%)	4.8	.000

Section 5:

Professional Development Content and Models

This section will summarize the projects professional development during the 2012-2013 project year. The discussion will focus on the various methods of professional development used by the eight Arkansas MSP projects, number of contact hours, and content of professional development.

Professional Development Methods and Models

In recent decades, school reform efforts have recognized teacher professional development as a key component of change and as an important link between the standards movement and student achievement. Many research studies have identified components of in-service teacher professional development programs that have an effect on practice and student learning. The first component is the substantial time that needs to be invested in the professional development experience for it to have an effect on practice and ultimately student learning. A review (Yoon, et al., 2007) of research studies with rigorous evaluation designs found that teachers who received an average of 49 hours of professional development, spread over 6-12 months, boosted their students' achievement by approximately 21 percentile points on standardized achievement tests. Conversely, professional development that offered 5 to 14 hours had no significant effect on student achievement.

The method in which professional development hours are distributed across time is also important. Having a concentrated learning opportunity through either workshops or institutes (typically held during the summer), with follow-up sessions to reinforce the learning from the intensive experiences, has been shown to be particularly supportive of teacher learning (Saxe, Gearheart, & Nasir, 2001). Research also suggests that professional development is most effective when teachers engage actively in instructional inquiry in the context of collaborative professional communities, focused on instructional improvement and student achievement (Wei, et al., 2009).

A prerequisite for change is developing a capacity for change. Thus, a major component of the MSP is to build the capacity for change through professional development for K-12 teachers and administrators, as well as through the involvement of IHE faculty in math, science, and education.

Funded projects must use funds to provide a minimum of 60 hours of intensive professional learning opportunities and a minimum of 24 hours of classroom follow-up per participant in the areas of mathematics and science. Each project held one week to two week long immersion seminars during the summer months with follow up activities throughout the school year. Each seminar focused on content and pedagogy appropriate to specific school levels (elementary and middle).

No Child Left Behind sets five criteria for professional development to be successful:

1. It is sustained, intensive, and content-focused.
2. It is aligned with and directly related to state academic content standards, student achievement standards, and assessments.
3. It improves and increases teachers' knowledge of the subjects they teach.
4. It advances teachers' understanding of effective instructional strategies founded on scientifically based research.
5. It is regularly evaluated to determine the impact on increased teacher effectiveness and student achievement (Birman, et al., 2007).

The purpose of the MSP program is to provide professional learning opportunities for teachers of mathematics that deepen teachers' subject matter knowledge. A common method of addressing teachers' subject matter knowledge was to engage teachers in subject matter-based activities targeting specific mathematics concepts. This approach included involving teachers in lengthy and intensive programs focused on subject matter, engaging teachers with subject matter-based activities, modeling strategies to help teachers connect subject matter to classroom activities, and facilitating roles involving university faculty.

The professional development activities offered by MSP projects focus on increasing teachers' content knowledge in mathematics, specifically content knowledge related to the new Common Core State Standards.

Lengthy and Intensive Projects

All Cohort 6 MSP partnerships focused their professional development activities around a summer institute which provided multiple, intensive learning experiences in mathematical content and pedagogical practices. Teachers then applied the content knowledge and pedagogical practices in their classroom during the school year. Teachers will come together one more summer to receive additional intensive training in content knowledge and discuss successes and areas needing improvement in a non-threatening environment.

In addition to providing intensive summer institutes, MSP projects offered a range of other professional development activities to participating teachers. The activities were offered as a follow-up to summer institutes to supplement material and concepts learned in those institutes. Half of the projects offered on-site professional development activities and half offered off-site professional development activities. All of the projects used Reformed Teaching Observation Protocol (RTOP) to assess baseline classroom practice

Content of MSP Projects

In their annual reports, projects provided the content of their professional development and identified the major topics within their discipline. Also included in their annual reports were the grade level and number of teachers involved in professional development activities. Since the focus of all projects in Cohort 6 was mathematics, only mathematical processes were covered in professional development activities. The projects differed in the grade range of participating

teachers and the math strands addressed (see Table 5.1). Overall, the projects emphasized new instructional strategies using standards-based materials aligned with the mathematics common core.

All MSP projects offered professional development in more than one content area, often focusing on topics relevant to the grade level of the participating teachers. Across MSP projects these areas included: mathematical practices, number and operations, algebra, measurement, problem solving, geometry, probability and statistics, reasoning and proof, ratios and proportional relationships, and modeling and functions. Since multiple topics were covered by different projects, teachers are counted each time they received professional development in a given area. For example, five projects covered mathematical practice and a total of 197 teachers received professional development in this area.

Table 5.1
Professional Development in Mathematical Processes Provided by School Level 2012-2013

Mathematics Content and Processes	Number Projects Providing PD	Number Elementary School Teacher	Number Middle School Teacher	Number High School Teachers	Total Number Teachers
Mathematical Practice	5	102	95		197
Number and Operations	5	82	91	3	181
Algebra	6	135	129	3	273
Measurement & Data	4	40	133		177
Problem Solving	5	49	163		217
Geometry	3	40	48		88
Probability and Statistics	2	17	85		102
Reasoning and Proof	3	85	10		95
Ratios & Proportional Relationships	3	40	10		50
Modeling & Functions	3	49	88		137

Recall that there were 313 reported participants. Looking at Table 5.1, it is clear that the majority of the teachers received information dealing with Algebra (273- 87%). Sixty nine percent of the teachers (217) had instruction in problem solving, and (197 - 63%) in mathematical practice. Ratios and proportional relationships and geometry were the least frequently addressed content areas with the number of teachers receiving instruction in these areas being 50 and 88 respectively.

At the elementary school level, the content area with the most participants was Algebra. The content areas with the least number of participants were probability and statistics. At the middle school level, the content area with the most participants was problem solving followed by measurement & data and Algebra.

All projects focused on mathematics for grade levels ranging from 3-8. However, one project had six high school teachers take part in professional development activities. The content

areas in which the three high school teachers were involved included Numbers and Operations and Algebra.

Table 5.2
Methods of Professional Development and Contact Hours by Project 2012-2013

Project Name	Summer Institute	On-Site PD	Off-Site PD	Total # of PD Hours	RTOP
6th-8th Grade Algebra Common Core Interactive Initiative	X		X	100	X
6th-8th Grade Geometry Common Core Interactive Project	X		X	100	X
Common Core Boot Camp	X	X		112	X
Getting to the Core	X	X		102	X
Math Core Team (MCT)	X	X		100	X
South Arkansas Mathematics Standards Partnership	X		X	100	X
Thinking Mathematically for Common Core State Standards in Grades 3-5	X	X		98	X
University of Arkansas Engineering & Mathematics Partnership	X		X	104	X

As required by the MSP and as shown in Table 4.2 all of the projects conducted summer institutes with school-year follow-up activities. During the summer teachers have more flexible schedules and the summer institute allows for professional development to be completed before the school year begins so that the new teaching approaches can be applied immediately when the children return to school. The average number of contact hours reported by the projects for 2012-2013 was 102 hours, up from 88 hours the previous year. Contact hours ranged from a minimum of 98 to a maximum of 112. All projects employed some form of follow-up sessions. Four projects offered on-site follow-up and four projects offered off-site follow up.

Unlike many professional development activities in which teachers are involved, MSP professional development provides intensive and sustained content-rich professional development from college and university faculty partners in STEM areas and colleges of education as well as from other professionals that integrates mathematics and science content with effective pedagogical strategies.

Modeling Strategies Connecting Subject Matter to the Classroom

Methods to help teachers connect the mathematics subject matter they were learning to the classroom setting were incorporated into most projects. Some participants reported using some of these techniques in their classroom the previous year.

One project commented: Our teachers reported that their continued "journey" in their development of student centered instructional strategies has challenged them yet has provided a number of exciting opportunities for students to illustrate their thinking. One teacher with 20+ years of teaching experience reported that her students loved being able to share their thinking with their classmates. …Sometimes during sharing out students would even volunteer their problems prefaced with, "it's the wrong answer, but I want you to see what I did and help me figure it out." The discussion that followed just blew me away. Students were eager to try to figure out where the problem went astray and offer advice for how to avoid similar problems next time." The project explained, "Our first two years of training appears to be having considerable impact on our teachers' knowledge of mathematics and their practice.

Another teacher said: "Looking back I am really happy with the implementation of this training and the common core. It was exciting to see students excited about math, using different strategies and showing a true understanding and relationship with the numbers and problems."

Some projects had concerns that it is hard for the training consultants to put into practice what they are teaching MSP participants about their lessons be "student directed" when MSP yearly professional development process is not "student directed" because of grant requirements to have a yearly syllabus submitted months in advance of the professional development training.

Section 6:

Project Evaluation Design

The Math and Science Partnership program represents a significant investment by the USDE. Accordingly, project-level evaluations are critical to helping the USDE understand and assess the value of its investment. Project evaluation should be planned to guide the annual assessment of progress and to measure the impact of the effort. Formative evaluation should provide evidence of the strengths and weakness of the project, informing the partnership's understanding of what works and what does not, in order to inform project evolution and success. Summative evaluation should give an objective analysis of qualitative and quantitative data, in order to determine the effectiveness of the project in contribution to positive student and teacher outcomes and institutional changes.

The MSP program seeks to improve student outcomes in mathematics and science for all K-12 students. Within the context of the MSP, the purpose of evaluation is to provide scientific insights grounded in evidence to document how the projects are implemented and how they can be improved by making data-driven decisions.

All MSP projects are required to gather data on teacher content knowledge and evaluate their own project's effectiveness. Projects are required to report on two aspects of their evaluation findings: 1) gains in teacher content knowledge based on pre- and post-testing; and 2) proficiency levels on state-level assessments of students of teachers who received professional development.

Quality professional development is accompanied by the demand of accountability. The ultimate worth of professional development supplied by the MSP projects is the essential role it plays in the growth of student achievement. This means that project staff must pay attention to the resultant impact professional development has on teacher effectiveness and student learning.

Project evaluation addresses the question: “Did the professional development work?” Consequently, each project should be accompanied by a well-designed evaluation plan to determine its effectiveness. This section describes the types of evaluators and evaluation designs used by MSP projects in Cohort 6, the measures used in evaluation, and teacher outcomes which are used to assess the effectiveness of the MSP interventions.

Evaluators and Evaluation Designs

All projects (8) in Cohort 6 reported using an external evaluator. Using an external evaluator allowed these projects to independently evaluate their work and to receive help from these specialists in implementing the most rigorous designs possible. All Cohort 6 projects used a quasi-experimental design with 25% (2) using a matched comparison group design and 75% (6) using a non-matched comparison group design. All projects used pre-tests and post-tests to assess the gains of the teachers served by the MSP. Projects used a variety of measures to conduct pre- and post-tests of teacher content knowledge.

All projects shared common goals: improving teacher content knowledge and teaching methods. And for all eight projects the primary target was individual teachers as opposed to whole school reform.

All of the project's evaluations have served a *formative* role. In this role, they have provided a project's directors with early feedback about the design and implementation of their project's activities. The directors can make adjustments and changes as needed to the following year's activities.

Overview of Data Collection

The legislation that authorizes the MSP program, Title II, Part B, Section 2202 (f) of the Elementary and Secondary Education Act of 1965 as amended by the No Child Left Behind Act of 2001 (P.L. 107-110), requires each of the projects funded by the states to submit an annual report to the U.S. Department of Education (USDE), documenting the partnership's progress in meeting its MSP goals and objectives. The state evaluation was conducted through an analysis of the annual required external evaluator reports that were submitted by each of the projects in 2013. Additionally, each project was examined regarding their teacher content knowledge measure. All MSP projects utilizing quantitative measures with a test previously established as valid and reliable were noted. These project directors were contacted to provide the pre- and post-test raw scores for each participant on their measure of teacher content knowledge.

Implementation fidelity is built into the state level evaluation framework. The state requirements rely on the local evaluation models using a variety of data sources to establish the levels of implementation of grant goals in participating teachers' classrooms. Although there are broad commonalities across grants, the unique scope and sequence of the content, strategies, resources, and technologies across programs precludes the use of a single implementation measure for everyone. In addition to the differences in goals and design, differences in local school settings require flexibility at the local grant level for measuring implementation.

Approaches and Strategies for Data Collection

The annual reports from the Arkansas MSP projects were examined by two members of the evaluation team. Annual reports were reviewed for consistency between project narratives and evaluation, the research and practice surrounding the method of professional development, utilization of appropriate statistical methods, and fidelity of implementation. Projects that were identified as having problems with statistical analysis and reporting were returned to the project directors, with feedback from the state evaluators on the appropriate changes to be made. The state evaluation team also requested additions to the evaluator's interpretation of the data where deemed necessary. Project directors were asked to have their evaluators reanalyze the data and/or rewrite the results, and resubmit these sections before the report would be accepted for final data collection.

For this evaluation report, all reports were read and summarized. In particular, the evaluation team examined the reports to determine how teacher subject matter and pedagogical knowledge were measured, and which evaluation design was utilized. Project participants,

professional development models, assessment instruments, and project implementation were also explored. The summaries were then examined for common practices and concerns across projects.

Data Analyses and Reporting

Descriptive statistics were used to analyze the report data (i.e., largely frequencies and means). The teacher content knowledge measure across projects was analyzed with a meta-analytic approach. All raw data scores were reviewed for complete data. Only participants with both pre- and post-test scores were included. All raw pre- and post-test score gains were analyzed with a Pearson correlation. This statistic was then examined with the corresponding Fisher Z-transformation in order to examine effect size of the projects. Data analyses are summarized in tables with appropriate explanatory narratives. The collected data yielded information to aid the evaluation team in making judgments and recommendations about the Arkansas MSP program initiative as a whole.

Data and Assessment

All MSP projects are required to gather data on their teacher content knowledge and evaluate their own project's effectiveness. The method of evaluation varies by nature of the project and the type of instrument/s used to measure teacher content knowledge. None of the projects used a true experimental design. All projects have attempted some form of quasi-experimental design.

The most frequently reported assessments of teacher content knowledge in mathematics were nationally normed/standardized tests (75% of projects). Locally developed assessments that were not tested for validity and reliability were the next most frequently reported type of assessment for mathematics. Student achievement outcomes were measured based on Arkansas Benchmark exams in mathematics.

As can be seen in Table 5.1 all projects gathered pre-test and post-test data to measure teacher content knowledge gains. The most commonly used assessment was the Diagnostic Mathematics Assessment for Middle School Teachers.

Table 6.1

Content Knowledge Instruments Utilized by MSP Projects

Instrument	Projects Using Instrument
Diagnostic Mathematics Assessment for Middle School Teachers	3
Diagnostic Teacher Assessment of Mathematics for Elementary Teachers	1
Learning Mathematics for Teaching	1
Full Option Science System	1
Mathematics Teaching Efficacy Belief Instrument	2
Number and Operations of Learning and Teaching Inventory	1
Locally Developed Using Questions from LMT	2
Locally developed	1

Note: Some projects reported using more than one assessment instrument and more than one assessment type.

Pedagogical Knowledge

In addition to teacher content knowledge, MSP projects also address pedagogical knowledge. Projects emphasize that teachers not only require stronger content knowledge but the skills to teach that knowledge. In order to assess teacher gains in pedagogical knowledge all projects used the Reformed Teaching Observation Protocol (RTOP) to measure classroom practices and beliefs. RTOP was designed by the Evaluation Facilitation Group of the Arizona Collaborative for Excellence in the Preparation of Teachers (ACEPT). RTOP was developed as an observation instrument to provide a standardized means for detecting the degree to which K-20 classroom instruction in mathematics or science is reformed. It is a 25-item classroom observation protocol that is (a) standards based, (b) inquiry oriented, and (c) student centered.

Attitudes and Perceptions

All projects assessed participants' perceptions and attitudes toward professional development by using a variety of Likert scale and open response surveys or questionnaire instruments for the purpose of formative and summative assessment. Feedback indicated a high degree of satisfaction with the workshops including format and content.

Section 7:

Conclusions and Recommendations

Conclusions

Completing the planned MSP activities is a critical first step toward the intended outcomes. Therefore this report gives considerable attention to the ability of the MSP to carry out the planned activities and to the quality of these activities. We found that the MSP has been very successful in completing the activities for Year Two. The majority of MSP activities were implemented as planned, and according to evaluations, were well received by participants.

Although it is too early to see achievement of long-term outcomes, examples of short- and mid-term outcomes are evident, such as increased awareness of research-based instructional practices and materials, increase in teacher content knowledge, increased collaboration among different partners and alignment of curriculum with professional development and State Common Core Standards.

This section will address the six evaluation questions guiding the statewide evaluation reports listed in Section One.

1. Did Arkansas' MSP projects provide professional development with significant and meaningful content that models the instructional strategies that will enable teachers to teach in a manner that will improve student achievement in mathematics?

Yes. There were research-based models for professional development implemented in all partnerships. Teachers report a better understanding of what is needed to change instructional practices. Some participants reported changes they made this past year as a result of the professional development they received last summer. According to the workshop evaluations, the majority of participants in the Arkansas MSP professional development activities said they felt better prepared to teach math and feel more confident to teach the Common Core.

Some participant comments include:

- I have learned several new strategies and activities that will help my students understand math.
- I have changed my thinking on using more hands-on activities and exploration. I have learned that teaching math is a discovery process for kids.
- I have been given lots of different lessons that can be used when teaching geometry that can be adapted for 3rd graders. We will have more time to slow down and makr sure the students really get it. More in-depth teaching of standards.
- I will be able to increase students' actual knowledge and understanding of fractions…not just memorizing skills.

2. Did Arkansas' MSP projects improve and upgrade the status and stature of mathematics teaching by encouraging IHEs to assume greater responsibility for improving

mathematics teacher education through the establishment of a comprehensive, integrated system of professional development that continuously stimulates teachers' intellectual growth and upgrades teachers' knowledge and skills?

Maybe. Fifty percent of the projects had an IHE as the lead organization. All projects involved STEM faculty, and many projects utilized education faculty as well, though in most MSP annual reports the level of involvement of the STEM faculty is not clear. Across all projects 38 IHE faculty were involved. The role of the IHE varied from partnership to partnership, including their role in governance and leading actual professional development. While IHE faculty were involved it is difficult to determine how much the status and structure of mathematics teaching has improved.

One IHE encourages participants to enroll in graduate school by allowing graduate credit for participation in the professional development. More for-credit options for teachers are needed in the partnerships to assist participants in attaining NCLB "highly qualified" status.

One issue still remains--with regard to promotion and tenure, many IHEs view faculty participation in the MSP as service to the community or teaching. This method of recognizing MSP participation is not of much value to faculty because they can gain service credits through other less labor intensive methods. Some IHEs are willing to recognize faculty participation if publications are forthcoming. For STEM faculty, this is a challenge since publishing in one's own discipline is more widely acknowledged as scholarly research than publishing in other fields. Most IHE faculty are given no research credit and very little service credit for working with the public schools. Therefore, it is not a priority for IHE faculty desiring promotion and tenure.

It should be noted, an assistant professor in the department of mathematics was promoted and awarded tenure this past year and a major portion of his research agenda is working with public school teachers. This is seen as a major accomplishment for those faculty in STEM areas who have been reluctant to become involved with the public schools if they are still in the tenure track.

3. Did Arkansas' MSP projects provide opportunities to focus on ways to deepen teachers' subject matter knowledge, increase teachers' knowledge of how students learn particular subject matter, provide opportunities for engaging learning, and establish coherence in teachers' professional development experiences?

Yes. All of the Arkansas MSP projects' professional development activities were designed to increase teachers' content and pedagogical knowledge. The projects focused on depth instead of breadth and provided hands-on classroom examples for engaging learning. Coherence was provided through each MSP project utilizing follow-up sessions to summer institutes or to sustained professional development throughout the academic year. Some specific participant comments include:

- I will be able to increase students actual knowledge and understanding of fractions…not just memorizing skills"
- I have changed my thinking on using more hands-on activities and exploration. I have learned that teaching math is a discovery process for kids.

- By showing several ways and examples on how to solve problems. And let students tell their strategies on how they solved the problem
- I have learned that there are a variety of ways to solve problems, and I need to encourage students to find several ways instead of just one. I also learned that I need to have students justify their answers better instead of just using a rule

4. Did Arkansas' MSP projects bring mathematics teachers in elementary schools and secondary schools together with scientists, mathematicians, and engineers to increase the subject matter knowledge of mathematics and/or science teachers and improve such teachers' teaching skills?

Yes. Of the 38 IHE faculty involved in the MSP projects, 29 of them were STEM faculty.

5. Did Arkansas' MSP projects develop more concise and rigorous instructional resources that are precisely aligned to state and local academic content standards and with the standards expected for preparation of students for postsecondary study in engineering, mathematics, and science?

Yes. Professional development activities were designed to prepare teachers for the state's Common Core. The intent of State Common Core Standards is to insure all students are prepared for postsecondary study in engineering, mathematics, and science. All partnerships rely on the theory that increased content knowledge of teachers and the ability to utilize effective pedagogical practice will translate into challenging courses and curricula. Some specific participant comments include:

- I think the leaders of the project did a wonderful job of instructing us on how to approach our lessons using the common core approach.
- I feel more confident in teaching common core algebra lessons and activities in my classroom. The atmosphere of the institute made me comfortable to ask questions and participate in discussions. I greatly appreciate the time, effort and interaction of the professors involved. One major benefit from being a lower level teacher, is seeing what learning on the horizon for my students and how to prepare them for it
- The MSP algebra project has given me more confidence and strategies than anything else to teach using common core strategies. It has helped me to grow professionally and increased my knowledge both about the way students learn and about the content needed to be taught

6. Did Arkansas' MSP projects provide opportunities to improve and expand training of mathematics teachers, including training such teachers in the effective integration of technology into curricula and instruction?

Yes, to some extent. Projects integrated technology into the curricula and instruction at varying levels. However, some participants commented that although they enjoyed the technology pieces they did not have access to that kind of technology at their schools. Others commented that they felt much more comfortable with the technology. Some specific comments include:

- This workshop is helping me to become more comfortable in changing my mathematical practices. I am still learning, but the examples presented are extremely helpful. I am still not comfortable with all the technology, however, each day I learn more and feel more confident to teach my students.
- Great presenters and great use of technology that will be useful in our classroom

Recommendations

Recommendations are organized into three categories: general, evaluation, and implementation. General recommendations are suggestions related to overall improvement of the MSP projects, and should be addressed by state level personnel, project directors, and project evaluators. Evaluation recommendations are specific to the evaluation component of the annual reports, and should be addressed primarily by project evaluators. Implementation recommendations are suggestions for improving the quality of the MSP projects through closer attention to fidelity of implementation, and should be addressed primarily by project directors.

General Recommendations

The following general recommendations are proposed:

- Research-based resources and tools should be readily available for all teachers.

- Project directors should work closely with the local evaluators on the importance of evaluating key measures. Each partnership needs to document the effectiveness of their projects. Where possible, more rigorous evaluation needs to take place.

- Beyond the scope of the three year grant period, evaluation needs to be conducted at the project level to determine the impact MSP has had on student performance. In what ways have student outcomes and course taking changed in K-12 schools implementing the MSP. If change occurred, what is the connection between implementation of the MSP plan and these changes? The overall bottom line for the MSP is to demonstrate improved student learning in mathematics and science. This imperative is reflected in the goals of the partnership.

- IHE faculty need to examine what they personally are learning from their involvement and begin to determine how that learning can be translated into institutional change. The learning that faculty and professors gain to enlighten their own practice is only the first step toward reforming pre-service and in-service programs throughout the state.

- Project directors should provide feedback to IHE administrators about the important contributions IHE faculty make to the public schools through MSP.

Evaluation Recommendations

- Project directors should include fidelity of implementation as part of the evaluation plan from the beginning of the project. The concept of implementation of fidelity is described and defined in the literature in terms of five elements that need to be measured including:

adherence to an intervention (program is being delivered as it was designed); exposure or dose (the frequency and duration of the intervention as prescribed by its designers); quality of delivery (the manner in which the teacher delivers the program); participant responsiveness (how much the participants are involved in the intervention); and program differentiation (identifying unique elements of the program and determining which elements or the program are essential for the program to achieve its intended effect).

- A description of the development process, validity and reliability should accompany all modified or locally developed used by projects. Thus, the fairness, accuracy, and credibility of the instruments can be established.

- In year three of Cohort 6, student assessment needs to be evaluated by specific teacher level data by all projects. Specifically, all students within project participants' classroom should be compared to non-participant classrooms when possible.

- All local evaluators should report raw scores for pre- and post- tests. Some evaluators report raw scores converted to IRT scores.

- Project directors should make sure that they are selecting or developing measures of teacher subject matter knowledge that reflect the emphases of the professional development and the grade levels served.

- Projectors directors and evaluators should follow the guidelines provided for high quality evaluations as outlined in "A Guide for Reporting on Rigorous Evaluations for the US Department of Education Mathematics and Science Partnership (MSP)."

Implementation Recommendations

The following implementation recommendations are proposed:

- Projects should explicitly indicate how professional development is driven by a comprehensible and sustained long-term plan with plans for continued access to professional development materials beyond the tenure of the project. This is extremely important in the Year 3 report.

- Documentation should be kept for any teachers that leave or enter MSP projects. If projects collect data on why teachers left or why they decided to join after the project had started, this can provide valuable information to project staff on how to improve the project.

- Losing project key staff while the project is progressing can greatly influence the impact of a project. Project directors and evaluators should address this more clearly by collecting data that describes how remaining project staff handled the loss in personnel and how the project staff perceived the impact on the project.

- Project directors should attempt to gain greater administrator involvement. Administrators are often recognized to be a pivotal factor in successful professional development efforts. By not including administrators, MSP projects have exclude an advocate for state and local policies and programs that reflect sustained MSP professional development models and frameworks.

Impact of MSP

Partnerships have worked hard to empower teachers to be leaders in their schools and share what they have learned about student-centered instructional strategies and ways to faithfully implement the common core with their school peers. Some teachers have reported that non-partner teachers have inquired of the partner teachers about methods of instruction and techniques to implement the common core. MSP teachers serving as leaders and helping others will help sustain the partnership beyond current funding.

The increased resources provided by the projects greatly contributed to a significant positive impact on the partner schools. Aligning the professional development training with state needs associated with integrating the Common Core State Standards in mathematics was extremely beneficial. This tight alignment resulted in a concentrated approach in developing the capacity of highly qualified math leaders on their respective campuses armed with increased knowledge and strategies specific to the challenges addressing the integration of Common Core State Standards in mathematics and the Next Generation Science Standards. Professional learning communities have developed throughout the projects.

Teachers are forming ties with university mathematics and education faculty, and this improved communication across school districts and between school districts and higher education should be beneficial to all involved

A continued increase in comfort level among the teachers was also noted in the use of technology as the participants gathered more experience in employing compressed interactive video (CIV). This led to reflections on the strengths of their own instructional strategies in their classrooms using technology

The timing of this professional development could not have been more perfect as virtually all school districts need major support in this area. With professional development focused on major mathematics learning strands, this resource is extremely valuable as the professors model the practices that are being asked of teachers in this new type of learning environment. The need for students to master these advanced concepts is vital to their overall academic success in mathematics, as both can be viewed as foundations to more rigorous mathematical, scientific, and engineering concepts. Overall, the increased content knowledge and experiences from the MSP project enabled teachers to feel more confident in relation to their increased mathematical knowledge and in their capacity to work with students in answering real world problems in a variety of contexts.

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Appendix

Project Summaries

This section will describe each project individually. All projects are listed alphabetically and contain key characteristics as provided by project directors in the MSP reports. These key characteristics are listed and described below in a model summary.

Project Title:

Project Abstract: (As written by the projector in the submitted annual report)

Stage of Implementation:
Stage 1: new (conducting start-up tasks such as formalizing partnerships and implementing the professional development model for the first time)
Stage 2: developing (revising, enhancing, or further developing professional development model)
Stage 3: Fully developed (all components of the planned MSP model are fully operational)

Total Teacher Participants: The total number of teachers and/or administrators participating in MSP professional development activities by grade level (elementary K-5, middle 6-8, or high school 9-12)

Project Title: 6th-8th Grade Algebra Common Core Interactive Project

The three year project's primary motivation is to meet the Arkansas Department of Education's statewide needs to prepare and enable 5th-8th grade teachers to understand and utilize the grade-specific Common Core State Algebra Mathematics Standards in a variety of settings. The need for intensive professional development to enable teachers to match instructional strategies for specific Algebra content knowledge, skills for core instruction, as well as interventions and extensions for problem solving by students.

THREE YEAR (2011-2014) GOAL I: Thirty five (35) 6th, 7th, and 8th grade algebra teachers in the 13 NEA Co-op member school districts will deepen their mathematical content knowledge of Common Core Algebra, develop interactive algebra lessons, and integrate the lessons into eBook for their classroom instruction over a three-year period.

Year II (2012-2013) Objective: Thirty-five (35) 6th, 7th and 8th grade Algebra teachers attended a ten-day Summer Institute (2013) and two Saturday school-year follow-up workshops to design and develop Common Core lessons and to share their experiences from September, 2012 through July, 2013.

Year II (2012-2013) Objective: Thirty-five (35) 6th, 7th, and 8th grade Algebra teachers from 13 school districts continued to gain content knowledge through two onsite RTOP classroom visits designed and developed around Common Core Algebra lessons during 2012-2013.

IMPLEMENTATION – YEAR II
In Year 2 (2012-2013) the project continued to stress the development of content knowledge among participants and begin to introduce Common Core lesson design and development of interactive lessons. Emphasis was placed on Algebraic thinking. Two classroom observations of participants teaching specific Common Core Algebra lessons were conducted by RTOP trained classroom observers. Two Saturday follow-up workshops were held during the 2012-2013 school year. The Year 2 ten-day Summer Institute was conducted in June-July, 2013 at the Northeast Arkansas Education Cooperative.

EVALUATION – YEAR II
A Project Assessment Team worked for eight months in Year 1 to ensure that an effective formative and summative evaluation plan was refined. An external evaluator and internal evaluator were employed to oversee a quasi-experimental evaluation design and implementation. The design compared participants with a control group. The valid and reliable 6th-8th grade Common Core aligned content knowledge teacher test was developed from LMT released items and incorporated into an online, secure test, which was administered by the NEA Co-op external evaluator at the end of the year to the MSP participants and a control group of 35 middle grades math teachers. Additionally, during the post-test (2) session an online Impact Evaluation Survey was completed by all MSP participants.

Stage of Implementation: 3

Total Teacher Participants: 35

Total Students Effected: 1700

Total Grant Amount and Cost per Participant: $162,353/$4,639

PD Contact Hours: 100

PD Model: 70 summer institute hours and 30 follow-up hours

Evaluation Design: Non-matched comparison group

Teacher Content Knowledge Instrument: Content Knowledge Test constructed from LMT items pre/post test

Type of Evaluator: External

University of Arkansas Engineering & Mathematics Partnership

Project Abstract: The University of Arkansas Engineering & Mathematics Partnership is a partnership of the University of Arkansas (UA) and public and private schools in northwest Arkansas (NWA) and eastern Arkansas (EA). The goal of the partnership is to provide increased content knowledge depth and content delivery tools that middle school teachers need to effectively implement the new mathematics Common Core State Standards (CCSS). The UA Engineering & Mathematics Partnership (UA-EMP) will focus on 6th-8th grade mathematics content areas that move one or two grade levels higher or lower than the current Arkansas Mathematics Curriculum Framework. This is the start of year two implementation of the University of Arkansas Engineering & Mathematics Partnership.

University of Arkansas participants include faculty and administrators from the mathematics department, the college of engineering, the college of education and the honors college. In addition, a mathematics specialist from the Northwest Arkansas Education Cooperative is actively involved in the program. The UA participants have a proven track record for designing and implementing highly successful curriculum related workshops and solid evaluations and results for middle school teachers, including Arkansas Department of Education grants.

Public and private school participants include administrators and 6th-8th grade teachers from 21 middle and junior high schools in northwest Arkansas and eastern Arkansas plus St. Joseph Catholic School (private) in NWA. Huntsville Public Schools (HPS) is the focus Local Education Agency (LEA) for the partnership. The UA-EMP aims to specifically target teachers who serve student populations of high poverty, high English Language Learners (ELL), or school in improvement.

The 2012-2013 (year 2 of the grant) academic year involved training consisting of four 1-day mini-workshops (two in east Arkansas and two in northwest Arkansas) an eight-day summer workshop, and classroom observations for each teacher. The content for 6^{th} and 7^{th} grade teachers focused on the number system as well as ratios and proportional relationships. The 8^{th} grade teachers focused on algebraic functions. In addition, all teachers received content training in probability and statistics.

An external evaluation utilizes both quantitative and qualitative measures. The evaluations provide guidance for continuous improvement to ensure the project achieves maximum results. Expected results are 1) improved teaching effectiveness, 2) increased student achievement scores, and 3) increased student and teacher enthusiasm in mathematics.

Stage of Implementation: 3

Total Teacher Participation: 81
Total Students Effected: 12,150

Total Grant Amount and Cost per Participant: $350,454/$4327

PD Contact Hours: 104

PD Model: Activities other than summer institutes only or summer institutes with follow up activities (8-day summer institute, two mini-workshops and RTOP follow-up visitation activities).

Evaluation Design: Matched comparison group design

Teacher Content Knowledge Instrument: Diagnostic Mathematics Assessments for Middle School Teachers

Type of Evaluator: External

Project Title: Thinking Mathematically for Common Core State Standards in Grades 3-5

Project Abstract: The "Thinking mathematically for Common Core State Standards (CCSS) in Grades 3-5" MSP project is a 3-year project developed by Henderson State University (HSU) and Dawson Education Cooperative (Dawson) to provide training in the new CCSS and cognitively guided instruction. The project's primary goal is to increase teacher content knowledge related to grade 3-6 common Core State Standards for mathematics and improve teacher classroom practice in grades 3-5 mathematics. The secondary goal is to improve student achievement on the relevant standards-based Arkansas mathematics examinations for students of teachers participating in the training program. Specific objectives include:

Objective 1: Twenty-seven (27) teachers of mathematics in grades 3-6 (participants) from 14 schools in the Dawson service area will demonstrate increased content knowledge related to the CCSS in grades 3-6 mathematics compared to teachers in a control group as measured by the Diagnostic Mathematics Assessment for Elementary Teachers after participating in an intensive, sustained program of professional development provided by HSU mathematics faculty and Dawson personnel between 2011 and 2014.

Objective 2: Participants will incorporate cognitively guided instructional practices in classroom instruction as measured by the Reformed Teaching Observation Protocol (RTOP) after participating in an intensive, sustained program of professional development provided by HSU mathematics faculty, Dawson personnel, and consultants from Teachers Development Group between 2011-2014.

Objective 3: A statistically significant percentage of the approximately 1,272 students taught by participants in each of the 2012-2013 and 2013-2014 school years will demonstrate greater achievement on the Arkansas Augmented Benchmark Examination in mathematics compared to students of teachers in a control group.

Stage of Implementation: 3

Total Teacher Participants: 27

Total Students Effected: 1272

Total Grant Amount and Cost per Participant: $139,622/$5,171

PD Contact Hours: 98

PD Model: Activities other than Summer Institutes only or Summer Institutes with follow up. (2 4-day summer institutes and 3 1-day workshops, one-on-one follow-up)

Evaluation Design: Matched comparison group design

Teacher Content Knowledge Instrument: Diagnostic Mathematics Assessment for Elementary Teachers (DMAET)

Type of Evaluator: External

Project Title: Common Core Boot Camp

Project Abstract: Common Core Boot camp (ASU-CCBC) is a partnership between Arkansas State University and public and private schools in north central Arkansas. The high-needs focus school district is Southside School District in Batesville. The overarching goal of Common Core Boot Camp is to promote ideas and ways of thinking that contribute to greater student understanding of the Common Core State Standards for mathematics in grades 3-7 by engaging teachers in learning experiences that strengthen their content knowledge, teaching methods, and use of materials and technology. The project will combine content knowledge of the concepts of fractions, decimals, percentages and content knowledge of the concepts of fractions, decimals, percentages and proportional reasoning with the progression of these concepts in the Common Core State Standards (CCSS) for mathematics.

The following were objects of the ASU-CCBC. By the end of the first year of the project:

1) 80% of participants will increase their content knowledge of fractions, decimals, percentages, and proportional reasoning as shown by a gain score of at least 20% using a valid and reliable content test.

2) 75% of participants will show an increase of 20% in levels of confidence in teaching fractions, decimals, percentages, and proportional reasoning based on CCSS for mathematics as measured by a self-efficacy survey and classroom observations using the Reformed Teaching Observation Protocol (RTOP).

3) 70% of the participants will have increased their use of technology in teaching as measured by self-reporting, classroom observations, and/or assessment by their administrators.

Professional development for the project began in October 2011 with teachers attending a kick-off session. In November, participants attended a short course on Common Core State Standards at the Arkansas Curriculum Conference. Instruction and collaboration continued throughout the winter and spring via face-to-face and distance interactions. The professional development culminated with an eight-day intensive summer institute in June 2012. Twenty-five teachers were provided at least 100 hours of professional development, and approximately 1000 students were served by these teachers.

The overarching goals of Common Core Boot Camp Year 2 were to promote ideas and ways of thinking that contribute to greater student learning of geometry, and data and measurement.

The following were objectives of the Year 2: By the end of the second year of the project, 1) 80% of participants will increase their content knowledge of geometry, and measurement and data as shown by a gain score of at least 20% using a valid and reliable content test; 2) 75 percent of participants will show an increase of 20 percent in levels of confidence in teaching geometry, and measurement and data based on CCSS for mathematics as measured by a self-efficacy survey and classroom observations using the Reformed Teaching Observation Protocol (RTOP); and 3) 70% of the participants will have increased their use of technology in teaching as measured by self-reporting, classroom observations, and/or assessment by their administrators.

Professional development for the project began in October 2012 with participants attending a kick-off-meeting. In November, teachers attended Common core Math Standards sessions at the

Arkansas Curriculum Conference. Professional development continued throughout the winter and spring using face-to-face and online sessions (10 hours). Professional development culminated with an eight-day intensive summer institute in June 2013. Twenty-one teachers were provided at least 100 hours of professional development, and approximately 1000 students were served by the teachers.

The evaluation plan for the project utilizes a multifaceted approach utilizing both quantitative and qualitative methodologies. A comparison group of teachers and students will also be recruited to participate, resulting in a quasi-experimental design. Comparison data will be collected, including outcome data and demographics. As much as possible, the evaluator will attempt to match comparison group and participant teachers on outcome variables and factors such as school size, gender, and experience teaching.

Stage of Implementation: 3

Total Teacher Participants: 21

Total Students Effected: 976

Total Grant Amount and Cost per Participant: $157,547/$7502

PD Contact Hours: 100

PD Model: Summer institute and on-site professional development during academic year

Evaluation Design: Non-matched comparison group design

Teacher Content Knowledge Instrument: Instructor generated test

Type of Evaluator: External

Project Title: 6th-8th Grade Geometry Common Core Interactive Project

The Wilbur D. Mills education Service Cooperative, Harding University, and 16 high-need member school districts have established a 6th, 7th, and 8th grade common core geometry interactive MSP project. This project has been designed to address the need of teachers to be actively involved in the implementation of the new Arkansas Common Core Mathematics Standards (CCSS). 2012-2013 was Year II of the project's implementation.

Sixth, seventh and eighth grade geometry teachers deepened their mathematical content knowledge of common core geometry, developed interactive geometry lessons, and integrated the lessons into their classroom instruction over a three-year period.

Year II (2012-2013) OBJECTIVE: Forty 6th, 7th, and 8th grade geometry teachers from 16 school districts will continue to gain content knowledge through the "unpacking" process, design and develop Common core lessons, and pilot the lessons in their geometry classrooms during the 2012-2013 school year.

Year I included intensive training of the CCSS Geometry "Learning Progression" process and "unpacking" process, which are the critical elements of the project that will result in the development of interactive lessons for Common Core 6th, 7th, and 8th grades in year II (2012-2013). The MSP participants attended two Saturday orientation workshops in the spring of 2012 and a ten-day Summer 2012 Institute. Experienced mathematics professors from the University of Central Arkansas, Arkansas State University, and Harding University lead the workshop and summer training activities.

In Year II (2012-2013) the project continued to stress the development of Geometry content knowledge among participants and began to explore in depth Common Core lesson design and development of interactive lessons. Emphasis was placed on geometric Thinking and applications. Two classroom observations of participants teaching specific Common Core Geometry lessons were conducted by RTOP trained classroom observers. The second ten-day Summer Institute was conducted in June-July, 2013 in the Harding University's Heritage Center facilities.

An external evaluator was employed to oversee the quasi-experimental evaluation design and implementation. The design has been established to compare participants and a control group of middle grade math teachers from the Northeast Arkansas Education Cooperative's member schools. The validity and reliability of a teacher content knowledge test is assured by the design of a 20-question Common core geometry pre/posttest, which is constructed for online, supervised administration. The questions are 6th-8th grade Geometry questions taken from the Middle grades (6-8) LMT's released question files. The MSP Geometry Assessment Team aligned the questions with the Common Core (6th-8th) Geometry Standards to match the content knowledge that will be emphasized in the three-year project syllabus. The MSP participants' scores are being compared against the control group scores to measure the differences made on an annual basis.

Also, at the completion of Year II, the mathematical achievement of students in the participating teachers' classrooms were measured using the Arkansas Mathematics benchmark test scores.

Additionally during Year II, an online impact evaluation questionnaire was taken to measure the qualitative aspects of the MSP Year II training sequence. This questionnaire was completed by MSP participants at the final day of the 2013 Summer Institute.

Stage of Implementation: 3

Total Teacher Participants: 40

Total Students Effected: 2527

Total Grant Amount and Cost per Participant: $163,323/$4083

PD Contact Hours: 100

PD Model: 70 hours Summer Institute and 30 hours on-site professional development

Evaluation Design: Non-matched comparison group

Teacher Content Knowledge Instrument: Middle School Geometry Learning Mathematics for Teachers (LMT)

Type of Evaluator: External

Project Title: Math Core Team

The Mathematics Core Team (MCT) is a professional development Institute that explores key concepts of the new Common Core State Standards curriculum in significant depths. The main goal of the project is to enhance teacher content knowledge and teaching skills that prepare students for success in the CCSS mathematics. The University of Central Arkansas (UCA); the Arch Ford Educational Service Cooperative; three high-need LEA school districts (Little Rock, North Little Rock, and South Conway County), Conway School District and a private school (Conway Christian) are partnering in this project. University of Central Arkansas participants include faculty and administrators from the mathematics department, and the UCA STEM Institute.

The MCT project started in 2011 and this is continuing into the year 2. The Mathematics Core Team (MCT) is a professional development Institute that explores key concepts of the new Common Core State Standards curriculum in significant depths. The main goal of the project is to enhance teacher content knowledge and teaching skills that prepare students for success in the CCSS mathematics. The project is based on the necessity for conceptual framework development of content in number operations, algebraic reasoning and geometry measurement (request from participants of year 1). Professional development for teachers will be designed with a clear trajectory of learning in place (learning progressions) including appropriate formative assessments to help guide the way and direct student learning. The proposed mathematics initiatives will align with the comprehensive implementation plan developed by the state implementation team.

The MCT project will provide a long-term sustained high quality professional development opportunity for 30 mathematics teachers from grades 3-6 for a minimum of 100 contact hours during each year of the project. There will be seven Saturday training during the academic year, one-week summer training, minimum of two follow-up classroom support and additional on-line support via dropbox. The project is based on the necessity for conceptual framework development of content in number operations, algebraic reasoning and geometry measurement (request from participants of year 1). Professional development for teachers will be designed with a clear trajectory of learning in place (learning progressions) including appropriate formative assessments to help guide the way and direct student learning. The proposed mathematics initiatives will align with the comprehensive implementation plan developed by the state implementation team.

Goal 1: Increase student performance in mathematics as measured on the adopted state measurements or other adopted exam in mathematics.
Objective 1: Students in the treatment classrooms will show a statistically significant increase in the percentage performing at proficient or above as compared to students in the control classrooms as measured by student scores on the Benchmark exam in mathematics or other adopted exam.

Goal 2: Increase the capacity of classroom teachers to provide high quality instruction in

number, operations, algebraic reasoning, and geometry measurement.
Objective 1: Increase teacher knowledge and capacity to provide classroom instruction in geometric and non-geometric measurement, geometry and data analysis through creating learning trajectories, developing formative assessments and structuring assessments based on student instructional needs as measured by classroom observation and lesson planning strategies.

Objective 2: Increase teacher knowledge and capacity to provide classroom instruction in geometry measurement through creating learning trajectories, developing formative assessments and structuring assessment based on student
To evaluate the success of the project, a quasi-experimental design with a delayed treatment for the comparison group will be used. A comprehensive evaluation that will use formative and summative assessments and include both qualitative and quantitative measures for each program goals will be conducted by an experienced external evaluation specialist from University of Arkansas Little Rock (UALR). DTAMS (Diagnostic Teacher Assessments in Mathematics and Sciences) Assessment Instrument developed by the University of Louisville, Center for Research in Mathematics and Science Teacher Development, to assess elementary and middle school teachers' content knowledge is used in this project.

Students. To measure summative gains in students' mathematical achievement, researchers will utilize scores from the Arkansas Augmented Benchmark Examination (Benchmark) and scores from a content exam constructed by the STEM faculty. The Benchmark examination is a combined norm-referenced and criterion-referenced test that utilizes the Stanford Achievement Test, Tenth Edition (SAT 10). According to the Arkansas Department of Education, scores on the Benchmark have "Technically sound levels of reliability, validity, and fairness, based on the extensive research that underlies both the CRT and NRT item sets" (Potter, 2011, p. 2). Additionally, the STEM faculty will create a content exam to more specifically measure students' knowledge of (a) geometry and measurement and (b) rationale numbers (specifically fractions, decimals, and percent).

Teachers. To measure teachers' mathematics content knowledge, the research team will administer the Diagnostic Mathematics Assessments for Middle School Teachers (DMAMS) in the content areas of Geometry/Measurements and Probability/ statistics. The CRMSTD used three strategies to ensure validity of the scores from the DMAMS and estimates of the internal consistency reliability of scores from the instrument exceed .86 for all content areas (CRMSTD, n.d.). Each assessment is comprised of 10 items, 10 multiple choice and 10 open response, with multiple versions to accommodate pre- and post-testing. Further, the assessments measure multiple types of mathematics knowledge including: memorized knowledge, conceptual understanding, problem/solving reasoning, and pedagogical content knowledge.
To assess the teaching skills of participating teachers, researchers will utilize the Reformed Teaching Observation Protocol (RTOP). The RTOP provides a "standardized means for examining classroom instruction in mathematics"

Researchers will also administer the Mathematics Teaching Efficacy Belief Instrument (MTEBI). The MTEBI contains 21 Likert-format items with 13 measuring Personal Mathematics Teaching Efficacy (PMTE) and eight Mathematics Teaching Outcome Expectancy (MTOE). Confirmatory factor analysis of responses from 324 teachers supported the two factors and the internal-consistency reliability estimates of the scores were .88 and .75 respectively.
The external evaluator will develop surveys and interview protocols to first ascertain participant needs and facilitate program development and, later, program satisfaction. The evaluator will also meet with directors to help monitor progress toward the 100 participant-contact hours per year.

Stage of Implementation: 3

Total Teacher Participants: 29

Total Students Effected: 2000

Total Grant Amount and Cost per Participant: $131,041/$4,519

PD Contact Hours: 100

PD Model: hours Summer Institute and on-site professional development

Evaluation Design: Matched comparison group design

Teacher Content Knowledge Instrument: Diagnostic mathematics Assessments for Elementary School Teachers (DTAMS)

Type of Evaluator: External

Project Title: The South Arkansas Mathematics Standards Partnership

The South Arkansas Mathematics Standards Partnership (SAMSP) is a collaborative effort of Southern Arkansas University, the University of Central Arkansas, South Central Service Cooperative, the SAU Education Renewal Zone (SAU ERZ) and the following school districts: Ashdown, Hope, Texarkana, Fouke, Harmony Grove, Junction City, Norphlet,Emerson-Taylor, Camden-Fairview, Smackover, Magnolia, Genoa Central, Foreman,Parkers Chapel, Stephens, Lafayette County, El Dorado, and Strong-Huttig. The ERZ partner is part of a PK-16 initiative funded by the state of Arkansas to identify and implement educational and management strategies designed specifically to improve public school performance and student academic achievement throughout the State. The majority of partnering school districts are high-need school districts that serve children from families where more than 25% of the students are on free or reduced lunch. Additionally, the majority of participating school districts are rural, isolated school districts with at least one building in school improvement.

SAMSP is designed to create and provide professional development activities to enhance both teacher content knowledge and instructional skills in two learning progressions identified in the Common Cores State Standards (CCSS) primarily for mathematics but science content is also addressed as a vehicle to teach mathematics in real-world contexts. The two learning progressions are Numbers and Operations, Fractions from grades 3-5 and Operations and Algebraic Thinking from grades K-5. In addition, the Measurement and Data domain in grades 3-5 and the Statistics and Probability domain in grades 6-8 from year one are still revisited as warranted when articulating with the current domains.

Forty 3rd -8th grade teachers from 17 school districts participated in the two-week Common Core Mathematics Standards Summer Institute on June/July 2013. Approximately one-half of the participants attended the summer institute at the South Central Service Cooperative in Camden, and the other half participated via CIV (compressed interactive video) broadcast from South Central Cooperative to Texarkana School District during both weeks. The summer institute included 10 days of intensive instruction to engage teachers in content-focused sessions in Numbers and Operations, Fractions, and Operations and Algebraic Thinking as well as continuing some aspects of measurement, data, probability, and statistics. Additionally, teachers participated in 6 follow-up professional development Saturdays and were visited by professors conducting classroom site visits at least twice during the academic year. Professors trained in the use of the Reformed Teaching Observation Protocol (RTOP) as an observation instrument provided a standardized means for detecting the degree to which K-20 classroom instruction in mathematics or science is reformed per the national science and mathematics standards. The research study / professional development activities provided a minimum of 100 contact hours during the first year of the project.
The identified goals of the South Arkansas Mathematics Standards Partnership were as follow: 1) increase teacher content knowledge in mathematics as measured by the Diagnostic Mathematics Assessments for Middle Level Teachers; 2) expand teaching skills of participants as measured by the Reformed Teacher Observation Protocol (RTOP); 3) increase student academic performance as measured by the Arkansas Mathematics Benchmark exams for students of participating teachers, and 4) create a sustained partnership among all partners/ participants to

address the implementation of the Common Core State Standards in south Arkansas.
An external evaluator collaborated with the project director to guide and monitor the project's formative and summative evaluation plan. The evaluation plan utilized a quasi-experimental research design. Separate control groups, one for teachers and one for students, were employed as a means to further measure and compare the impact of this particular professional development model on teacher content knowledge, teaching skills, the integration of the Common Core State Standards into classroom practices, and student performance on standardized state benchmark exams.

Stage of Implementation: 3

Total Teacher Participants: 40

Total Students Effected: 1605

Total Grant Amount and Cost per Participant: $167,807/$4,195

PD Contact Hours: 100

PD Model: 60 hours Summer Institutes with 40 hours follow-up professional development

Evaluation Design: Non-matched comparison group design

Teacher Content Knowledge Instrument: Diagnostic Teacher Assessments in mathematics and science (DATMS)

Type of Evaluator: External

Project Title: Getting to the Core: Grades 3-5 math & Science Partnership
The "Getting to the Core" partnership is comprised of 40 grades 3-5 teachers from school districts in Northwest Arkansas, faculty from the Department of Mathematical Sciences and College of Education and Health Professions at the University of Arkansas (UA), and the Northwest Arkansas Education Services Cooperative (NWAESC). The goals of this project are:

1. To improve teachers' content knowledge and pedagogical content knowledge with respect to the mathematics that comprise the grades 3-5 curriculum in the Common Core State Standards for Mathematics;
2. To increase student achievement in mathematics across the various content strands, including Number & Operation, Algebra, Geometry, Measurement, and Data; and
3. To impact teacher practice by emphasizing and exploring student-centered methods of instruction.

To achieve these goals, we have designed and are implementing a three-year focused professional development in the areas of
• Whole number/base 10 operations & algebraic reasoning (Year One)
• Fractions & multiplicative reasoning (Year Two)
• Data, Measurement, & Geometry (Year Three)
These three areas comprise the mathematical content strands across the grades 3-5 Common Core State Standards.

The Getting to the Core's professional development model is based on the latest research on how students think about and process these mathematical concepts and is being led by leading researchers in the field of mathematics education. Summer workshops and school-year follow-up workshops, including classroom-embedded professional development, have been and will be used for content delivery. The content of the summer workshops will focus both on students' informal approaches to solving problems across the mathematical areas under study each summer as well as their connections to more abstract concepts and procedures. Problem types and related areas under investigation will be explored in detail as well as anticipated trajectories of students' progression of strategies from these initial starting points. Teachers have been and will also be engaged with ideas regarding how the Standards for Mathematical Practice can be incorporated in mathematics lessons and how these skills can be developed in students.

Stage of Implementation: 3

Total Teacher Participants: 40

Total Students Effected: 1225
Total Grant Amount and Cost per Participant: $129,229/$3,231

PD Contact Hours: 102

PD Model: Summer Institute and on-site professional development

Evaluation Design: Non-matched comparison group design

Teacher Content Knowledge Instrument: Learning Mathematics for Teaching (LMT) and Number & Operation Teaching and Learning Inventory

Type of Evaluator: External